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INDUSTRIAL NOTES..... 20

The Cape Cod Canal Co., chartered June 9, 1893, as the Old Colony & Interior Canal Co., has received permission from the commissioners appointed under the act of legislature to proceed to raise money on the strength of its securities. The certificate given says that the capital stock will be $7,500,000, and the 5% bonds will amount to $7,500,000 more. The company must now deposit with the state $50,000 within the next 30 days and $150,000 within 60 days as security for faithful performance of work. By the terms of the charter, if work is not actually commenced by June 9, 1894, $50,000 will be forfeited to the state; and if three-fourths of the trunk of the canal is not excavated before June 1, 1898, $100,000 will be forfeited to the towns of Bourne, Dennis or Yarmouth. If the canal is not built in five years from June 9, 1893, the corporation ceases to exist and all its property becomes the property of the state. Meanwhile, petitions are pending for the incorporation of two other companies to build canals from Buzzard's Bay to Barnstable Bay and by way of the Bass River route.

The English railways are fighting the Manchester Ship Canal, says the "Pall Mall Gazette," by attempting to increase rates between the canal wharves and the consuming centers, and by decreasing the rates from Liverpool to Manchester by rail. The same journal says that it takes two days for an ocean steamer to traverse the canal, and that the charge is about 6 shillings per ton more than to Liverpool.

An ordinance empowering the Northwestern Elevated R. R. Co. to build an elevated railway on the "North Side" has been passed by the Chicago City Council. The route of the road, as given in the ordinance, is as follows:

1. The main line of said road shall commence at Congress St., or at a street or point north of Congress St., and between Wabash Ave. on the east and Market St. on the west, and extend in a north or northwest direction to the Chicago River; thence across the Chicago River to a point between Cass St., thence to the Chicago River and the North Branch of the Chicago River, thence in a north or northwest direction to the city limits.

2. The first branch of said road shall commence at the main line at a point north of Van Buren St. and south of the Chicago River, and run west across the South Branch of the Chicago River to a point not more than 1,000 ft. west of Halsted St., and continue with two branches—one running northwest to the city limits and one running north to the city limits.

3. The second branch shall commence at the main line, between North Ave. and Chicago Ave., and extend west to a point between Western Ave. and Ashland Ave.; thence north to the city limits.

4. The third branch shall commence at the main line between North Ave. and Diversey St., and extend north or northeast to the city limits.

5. The fourth branch shall commence at the main line between North Ave. and Belmont Ave. and extend west to the city limits.

The ordinace further provides that the right of way shall be condemned and that the river may be crossed by a bridge or a tunnel. Two tracks are to be laid 5 miles within three years after the acceptance of the ordinance. Within 90 days after the acceptance of the ordinance the company is to deposit with the city treasurer $100,000 in cash or bonds as a guaranty for the faithful performance of the conditions of the ordinance. The capital stock of the company is $15,000,000, and the incorporators are Edward W. Russell, W. E. Anthony, Bion J. Arnold, Harold Sturges, E. Buckingham and Frederick Sargent. The stock is assured by the Mutual Illinois Trust & Savings Co.

The headings of a 2,000-ft. rock tunnel to connect the Byam River with the Kensico reservoir of the New York water supply, met on Dec. 28. The work has been in progress for two years.

Torpedo boat No. 2, the "Ericsson," is soon to be launched at the Dubuque Iron Works, Dubuque, Ia., 1,500 miles from the ocean. The "Ericsson" is 150 ft. long, 15½ ft. beam, 4¾ ft. draft, and has a displacement of 120 tons. With an I. HP. of 1,800 she is to have a speed of 24 knots per hour. The contract price for the hull and machinery is $113,500.

The most serious railway accident of the week was a rear collision which occurred Jan. 2 between a Union Pacific mixed train and a Chicago, Rock Island & Pacific freight train. The single track line between Topeka and Kansas City is used jointly by the two companies, and the Rock Island train crashed into the rear of the other at a point ten miles east of Lawrence. Four men were killed and four seriously injured.

The coroner's jury which investigated the trestle accident on the Western New York & Pennsylvania, reported in our issue of Dec. 21, found that: "The accident was caused by an unusually large volume of water passing through the trestle at the time, and by some weakening of the bridge which might have been produced by the removal of the New York, Chicago & St. Louis Ry. part of the bridge." It is said that the accident has resulted in the condemning of several trestles and the temporary abandonment of the line between Corry and Brockton during the rebuilding of the trestles.

Three boiler explosions are reported, one in a sawmill near Knoxville, Tenn., killing 4 persons and injuring 3; one in a sawmill near Peru, Ind., killing 2 persons, and one at the Philadelphia Oil Refinery, killing 2 men. The last named was a new boiler and was being tested when the explosion occurred, a forcible example of the danger of using steam pressure for testing.

The Pennsylvania R. R. system increased its total trackage 546.88 miles in 1893, making the total extent of the company's tracks at the present time 14,825.15 miles. Of this total, 8,111 miles is "first track," 2,298 miles is second, third and fourth tracks, and 4,417 miles is sidings. It is of interest to note that while the first track increased only 131 miles during the year, the second, third and fourth tracks increased 285 miles.

Steel barrels are being made by an English firm which are claimed to meet the requirements of durability and ready repair. The bodies are made from rectangular steel sheets from 1-10 to ¼ in. thick. These sheets are manipulated by special machinery into a proper bulge, and the edges are welded together by electricity. The ends are stamped out cold from rectangular sheets, with a circular flange for insertion into the body and circular corrugations for strength. The ends are fastened in by being tightly jammed between an inside and an outside hoop of steel, and these are then fused together electrically. The central bung ring is welded to the inside of the barrel, and the end bung ring to the outside. Used for petroleum, these barrels carry 50 gallons of oil in the same space required for 40 gallons with a wooden barrel.

Fast time is being made by freight nowadays, as well as by passengers. A carload of buggies was shipped from Buffalo, N. Y., at 10:10 a. m., Dec. 2, and arrived at its destination, Los Angeles, Cal., at 3:20 on Dec. 11, having been 8 d., 7 h., 10 min. on the way.

The Boston Subway Commission, it is announced, will consist of Messrs. Thos. J. Gargan, George F. Swain and Chas. H. Dalton. Prof. Swain is already well known to many of our readers as engineer to the Massachusetts Railroad Commission and Professor of Civil Engineering in the Institute of Technology. Hon. Thos. J. Gargan has been the selected representative of Tremont St. property holders in some recent issues, and is a man of recognized public spirit and ability. Mr. Dalton is a prominent business man, and was at one time a member of the Park Commission. The appointments give entire satisfaction in Boston, we are advised, and make it tolerably certain that the new project will be skillfully and faithfully carried out.

A 36-lever interlocking plant was put in operation at Columbus, O., on Dec. 10, controlling tracks of the Cleveland, Cincinnati, Chicago & St. Louis, the Lake Shore & Michigan Southern, the Lake Erie & Western, and the Sandusky & Columbus Short Line. The plant was built and put in place by the National Switch & Signal Co., of Easton, Pa., and controls 17 switches, 17 locks and 27 signals. Three separate crossings are operated from a single tower, one of them 1,700 ft. distant from it. The farthest signal is 4,000 ft. from the tower. The plant was completed in September, but owing to some unsettled questions between the railways interested there was about three months' delay in putting it in service. No attention was paid to the outside work during this time, but it remained in perfect order, and on the day it was put in service a one-armed operator moved all the levers without difficulty.

The city of Allegheny is considering the introduction of a new water supply and has taken action to obtain bids on three different plans: For a temporary pumping plant, a permanent direct pumping plant without filters, or such a plant with filters. Mr. Julian Kennedy, M. Inst. M. E., has reported on a complete new supply system with estimates of $710,000 for pumps, $800,000 for a steel conduit and $300,000 for filters, besides smaller sums for other feautres, making a total of $1,925,000. A purer supply is greatly needed.

The public buildings of the United States cost, for the year ending Sept. 30, 1893, the sum of $4,126,150. Of this sum $3,787,943 was expended for sites and construction of new buildings.

Fiber-graphite, the new material for bearings, which requires no lubrication, is now being put on the market by the Link-Belt Companies of Chicago and Philadelphia. Fiber-graphite is a mixture of wood pulp and flake graphite, molded to the form desired, and was fully described in our issue of May 19, 1892. Hangers, pillow blocks, boxes and bushings for use on shafting are now ready for the market, and special boxes for fans, blowers, sewing machines, cable pulleys, etc., are also made. The limit of journal pressure at which the material works successfully is stated to be about 50 lbs. per sq. in. There is no limit as to speed; in fact, a chief value of the material is that it operates successfully on journals where high speed makes the lubrication of ordinary bearings exceedingly difficult. Thus, while fiber graphite is not available for heavily loaded bearings, such as car journals, it is applicable to a wide range of bearings run under ordinary loads, and as it entirely dispenses with the use of oil, it seems destined to work a real revolution in machine design.

THE SALT LAKE CITY INTERCEPTING AND OUTFALL SEWER.

(With inset.)

By W. P. Hardesty.

Salt Lake City is situated on the eastern slope of the basin of the Great Salt Lake and is quite diversified in topography. All of the northeast and extreme eastern portions have good natural drainage with slopes which gradually become lighter toward the southwest until the southern and western parts are nearly level. The Jordan River flows from south to north through the western part of the city, emptying into the Great Salt Lake, some eight or ten miles northwest of the center of the city. The territory on each side of the river is quite difficult to sewer, the only fall being along the course of the river, less than 2 ft. per mile at first and decreasing before the city limits are reached, so that the river becomes quite sluggish, with low-lying ground and lakes on each side. To the west, toward Great Salt Lake, the surface is practically level, with no opportunity for drainage in that direction.

The population of the city in 1890 was about 45,000 and is now estimated as from 55,000 to 60,000. The area within the city limits is about 40 sq. miles, much of which is unsettled and will not need sewers for a long time.

Prior to 1889 Salt Lake had no sewerage system and in that year the first systematic attempt at disposal of waste matters was made. The sewage was led down Fifth South St. to a sump at the river bank, from which it was pumped through a 12-in. kalamein iron pipe for two miles to the westward and emptied into a surplus canal, built to relieve the Jordan during heavy freshets, and finally discharged into Great Salt Lake. The pumping plant has proved to be much too small. It has a capacity of but 850 gallons per minute and disposes of but about 40% of the sewage delivered to it during the 18 hours per day it is operated, leaving the balance to be discharged directly into the river. The sewage has been a nuisance to parties living along the river and even a worse one to those in the vicinity of the surplus canal, and as it became evident that the disposal of all the sewage by pumping would be very expensive, the small amount at present pumped alone costing $5,000 per annum, it was decided that a new outlet must be secured.

A gravity sewer carrying off the sewage and discharging it some place north or northwest of the city was the only solution that could be offered. Surveys and plans were made by Mr. A. F. Doremus, M. Am. Soc. C. E., City Engineer, and approved by Mr. J. J. R. Croes, M. Am. Soc. C. E., of New York. The plans as adopted call for a masonry sewer, shown by the map, Fig. 1, on the inset sheet, beginning at Fourth East and Ninth South St. and extending through the city to vacant ground about one mile north of the city limits designed for use as a sewage farm. It is believed that this plan will dispose of the sewage in a satisfactory manner and at the same time render it of commercial value. All available water in this locality is eagerly sought for use in irrigation and it is thought that the sewage will fertilize as well as water the crops to which it is applied, while its higher temperature than ordinary water will be an advantage. A tract of 120 acres has been secured by the city to be used as a sewage farm and in time sewage will probably be sold to parties owning adjoining lands.

The sewer is designed to intercept the sewage from all that part of the city lying 25 to 30 ft. above the Jordan River, it being estimated that some 3,000 acres will eventually discharge into it. This area includes the best residence portion and the business center of the city and will probably furnish the bulk of the sewage for a long time to come.

As designed the total length of the intercepting and outfall sewer will be 41,400 ft., or nearly eight miles, the length and the quantities per lin. ft. of each size being as follows:

Diameter, ins.	38	42	48	54	61
Length, ft.	5,200	5,300	5,600	9,800	17,500
Concrete, cu. yds.	0.295	0.326	0.375	0.623	0.739
Brick, cu. yds.	0.109	0.118	0.132	0.222	0.261
Cement plaster inside, sq. ft.	1.165	1.222	1.396	1.521	1.862

The grade of the 38 and 42-in. sections, including the first two miles, is 0.05, and of the balance 0.04 in 100. Through the settled portion of the city the street line is followed, the sewer being laid 22 ft. from the center line, with 90° curves of 127.32 ft. radius.

Manholes are located 800 ft. apart and vitrified branch connections are placed at all street intersections and about 800 ft. apart elsewhere, within the city limits. The great size of the blocks of Salt Lake, 660 ft. sq., with 132-ft. streets, lessens the outlay for laterals, but will greatly increase the cost of house connections, many of the houses being located in the interior of the blocks.

At Second South St. a 2-ft. masonry branch will be built for connecting a main, to be built at some future time, through this street to the east end of the city, where it will receive the sewage from Fort Douglas—a United States military post situated on the bench lands, some three miles east of the center of the city. At this point the size is increased from 42 to 48 ins. At North Temple St. another 2-ft. masonry branch is to be built in the sewer to admit the surplus water of the City Creek, at present conducted west on this street through open paved conduits and flumes to the Jordan River. In time, however, when the growth of the city will require the full capacity of the sewer, this method of disposing the surplus water will have to be abandoned, and instead a main branch sewer will connect at this point. Here the diameter of sewer increases to 54 ins. At Ninth North St. a 3-ft. masonry branch will be built to admit sewage from the district below the gravity sewer. It is here that the sewer reaches its full size of 64 ins., with an estimated capacity of 35,000,000 gallons daily, which will certainly be sufficient for the city for many years to come.

In designing the sewer Mr. Doremus presented two alternative methods of construction, one calling for a combined brick and concrete structure, as shown in the sections, Figs. 2 and 3, while the other used brick alone, the brick section being continued clear around and the same thickness.

Following are the amounts of the respective kinds of work upon which bids were invited, together with the prices and corresponding amounts bid by the successful bidders, Houlahan, Griffith & Morris, of Salt Lake, and Hobson & Wilkerson, of Ogden:

Nature of work.	Quantities.	Price.	Amount.
Earth excavation	73,700 cu. yds.	.40	$29 480
Earth excavation and back filling	116,000 "	49	56,840
Solid rock excavation.	10 "	$6.00	60
Solid rock excavation and back filling	50 "	7.00	350
Embankment	500 "	.25	125
Tunneling in earth	25 lin. ft.	11.25	281
Tunneling in solid rock.	350 "	17.00	5,950
Concrete masonry	23,700 cu. yds.	6.69	158,553
Brick masonry	8,400 "	9.99	83,916
Cut stone masonry	50 "	20.00	1,000
Rubble masonry	200 "	6.50	1,300
Dry rubble masonry	200 "	4.50	900
Cement plaster	65,370 sq. yds.	.33	21,572
Rip-rap	500 cu. yds.	2.00	1,000
Lumber in the work	2,000 M. ft. B. M.	30.00	6,000
Total			$367,327

The only change in quantities for the all-brick construction was that 25,400, instead of 8,400, cu. yds. of brick masonry were required, and only 500 cu. yds. of concrete. The bids for construction with brick alone were nearly $15,000 more than those given above. The same contractors were the lowest bidders in each case. The choice between the two plans rested with the city engineer and Board of Public Works, under whom the work is being done, subject to the confirmation of the city council, and was somewhat complicated by the efforts of parties interested in the selection of materials. The old arguments as to the use of home material and greater employment for the laboring man were urged with much zeal. The city engineer preferred the combined construction and it was finally adopted.

Fig. 2 shows a section of the 32-in. portion of the sewer; the 42 and 48-in. portions have the same thickness of brick and concrete. Fig. 3 shows the 64-in. portion which has the same thickness of material as the 54-in. A special 64-in. section, used beneath three railway crossings, referred to below, is shown by Fig. 4.

The specifications call for the best hard-burned brick laid in Portland cement mortar, composed of 1 part of cement and 2 parts sand. The concrete is composed of 1 part Portland cement to 4 parts sand and 5 parts of screened gravel. The inside of the sewer is plastered with a mortar composed of 1 part Portland cement and 1 part sand, a coat ½ in. thick being laid on. The outside of the brickwork also receives a coat ½ in. thick of the mortar used in its construction.

The style of manhole is shown by Figs. 5 and 6, Fig. 5 showing a manhole in the 42-in. section, that in the 38-in. being similar, and Fig. 6 showing a manhole in the 64-in. portion of the sewer, the same type having been used for the 48 and 54-in.

Fig. 7 shows the details of the manhole covers, as designed. The locking device is simple in construction and admits of ease and certainty of operation. Fig. 8 shows the connection for the force mains from the proposed plant near Ninth North St.

It is proposed at some distant day to collect all the sewage from the bottom lands along each side of the Jordan and conduct it by a sewer paralleling the river to a sump at Ninth North St., thence to be pumped against a head of probably 20 ft. along this street into the gravity sewer. The route of the sewer as adopted is, in general, quite direct, necessitating some very heavy cuttings and some fills. At Hot Springs, a bathing resort in the northern part of the city, a spur from the mountains projects well out into the valley, at the point of which are located the springs. Here a tunnel 375 ft. in length has been put through without any difficulty, the material being mostly a stiff clay or shale that required but little timbering and allowed of a very clean and uniform cross-section, thus requiring very little extra excavation outside of the sewer section. About one-half mile north of the city limits the Great Salt Lake & Hot Springs Ry. is crossed at an acute angle, requiring 104 ft. of a special construction, while farther on the Union Pacific and the Rio Grande Western railways are crossed at a still more acute angle, requiring each 150 ft. of the special construction. As the intrados of the sewer arch is but about 4 ft. below the rails for each of these three crossings, a very strong and substantial construction had to be adopted, which is shown in Fig. 4. The cost of the sewer where built after this section will be about $20 per lin. ft. The cost of the masonry alone of the 64-in. sewer, as shown in Fig. 3, will be about $8 per lin. ft.

Trouble with water has been experienced in the construction of the sewer, and for much of its length drain boxes have been used. A layer of gravel has been placed below much of the concrete bottom and plank foundations have been employed in some very wet places. But little trouble has been experienced from caving, even in very deep cuts, bracing, of course, being freely used. A trench 7 ft. 5 ins. in width answers for the largest size of the sewer. Lagging, of course, has to be used in shallow cuts and in fills to form the back of concrete walls while being built. Figs. 9 and 10 are views of the sewer in process of construction.

About 14,000 ft. at the lower end of the sewer will be finished in 1893 at a cost approximating $180,000. It will probably take until the end of 1894 to complete the work.*

THE RELATIVE POWERS OF GUNPOWDER AND NITRO-GLYCERINE.

At a late meeting of the English Society of Civil Engineers, Mr. Perry F. Nursey, Past President, read a paper entitled "Some Practical Examples of Blasting." The first portion of his paper was devoted to setting forth the comparative actions and powers of gunpowder and nitro-glycerine, and this part is given in abstract as follows:

Commencing with gunpowder, Abel is quoted as stating that this compound yields upon explosion 43% by weight of permanent gases and 57% of matter which is solid at ordinary temperatures, but part of which may exist as vapor when the powder is exploded under pressure. At 0° Cent.

* We have received a letter from Mr. A. F. Doremus, City Engineer, dated Dec. 20, 1893, in which he states that on account of unfavorable weather the work has been stopped for some time; also that there is a controversy between the city and the contractors, which may result in a mutual agreement for the abandonment of the contract. In any case it is expected that the work will go on in the spring.

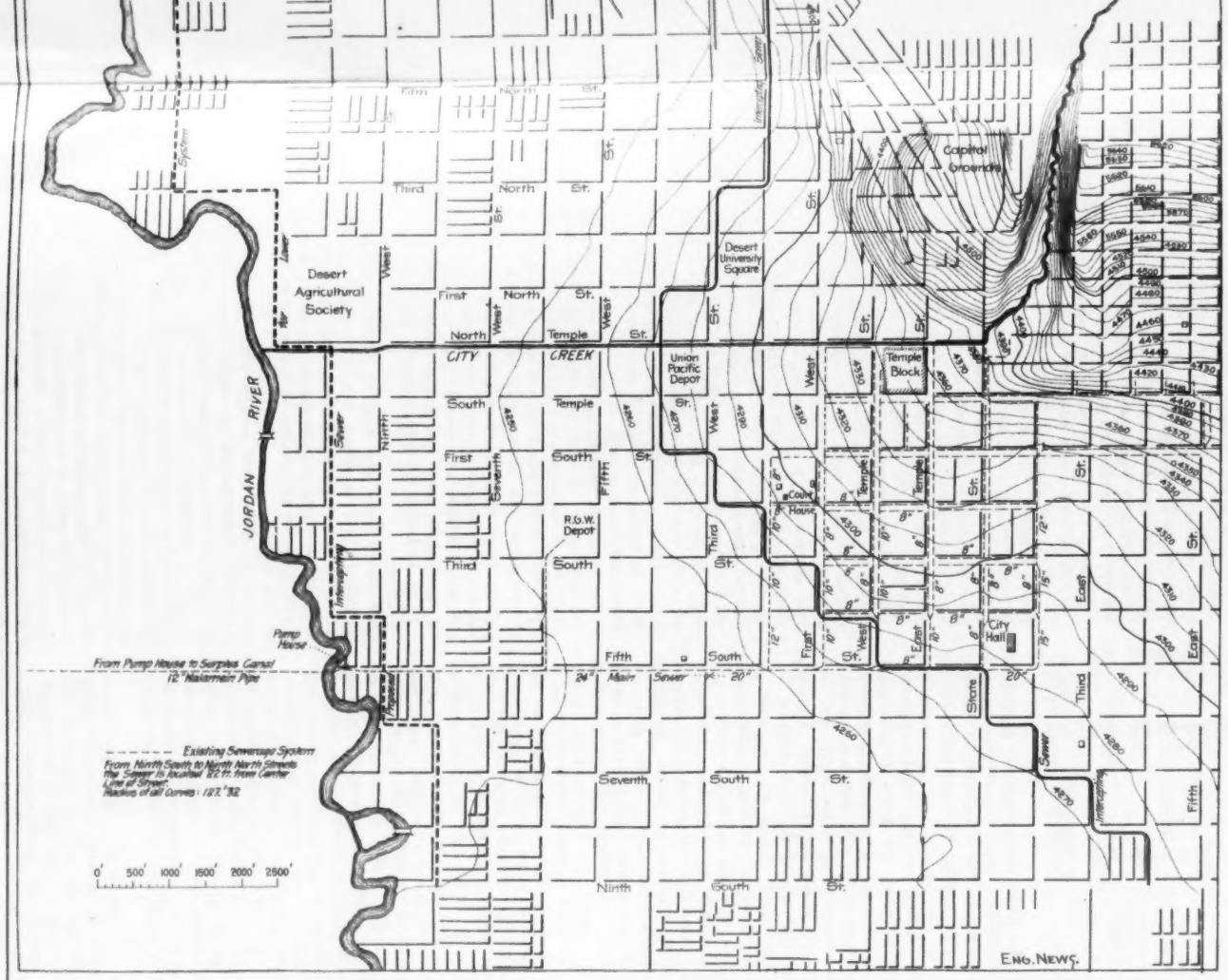
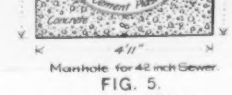
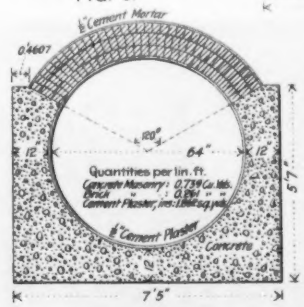


FIG. 1.
MAP SHOWING INTERCEPTING AND OUTLET SEWER.

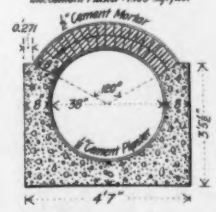


Manhole for 42 inch Sewer.
FIG. 5.

Manhole for 64 inch Sewer.
FIG. 6.

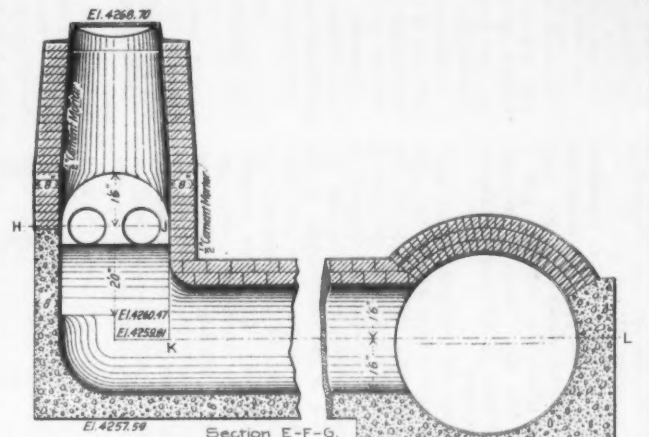


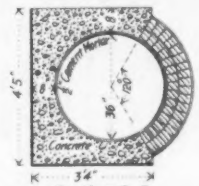
Section of 64 inch Sewer.
FIG. 3.



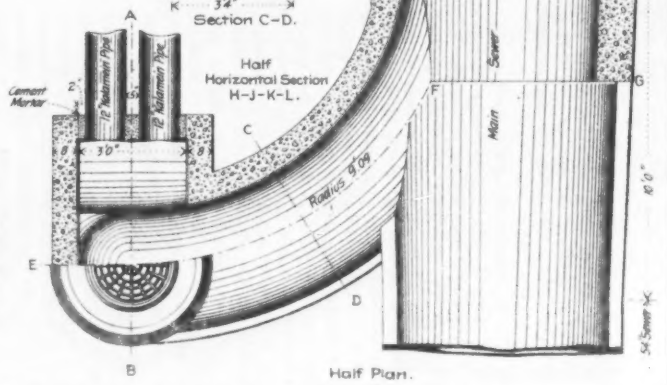
Section of 38 inch Sewer.
FIG. 2.

GENERAL TYPES OF SEWERS AND MANHOLES.





Section C-D.



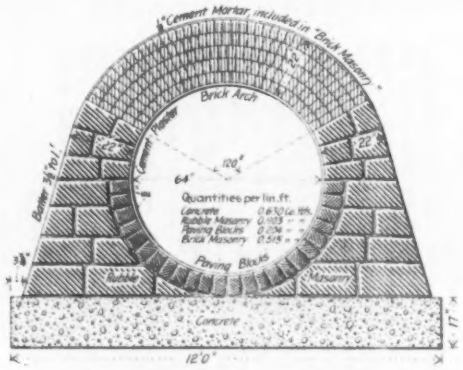
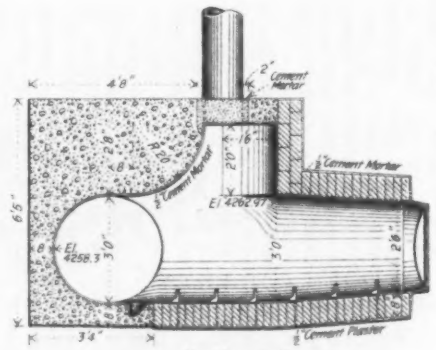


FIG. 4. SPECIAL SECTION BENEATH RAILWAYS.



Section A-B.

FIG. 8. CONNECTION BETWEEN OUTLET SEWER AND PROPOSED FORCE MAIN.

INTERCEPTING AND OUTLET SEWER AT SALT LAKE CITY, UTAH.

A. F. Doremus, City Engineer, M. Am. Soc. C. E.

CHAS. HART & SONS, LITH., 35 VESEY ST., N. Y.

FIG. 9. VIEW SHOWING LINE OF SEWER READY FOR BRICK ARCH.

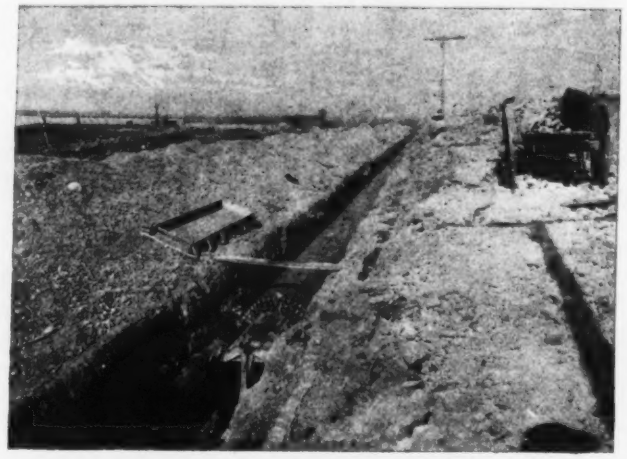
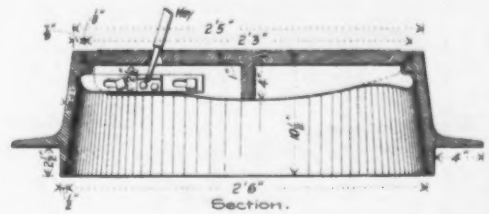


FIG. 10. VIEW OF SEWER READY FOR BACK-FILLING.



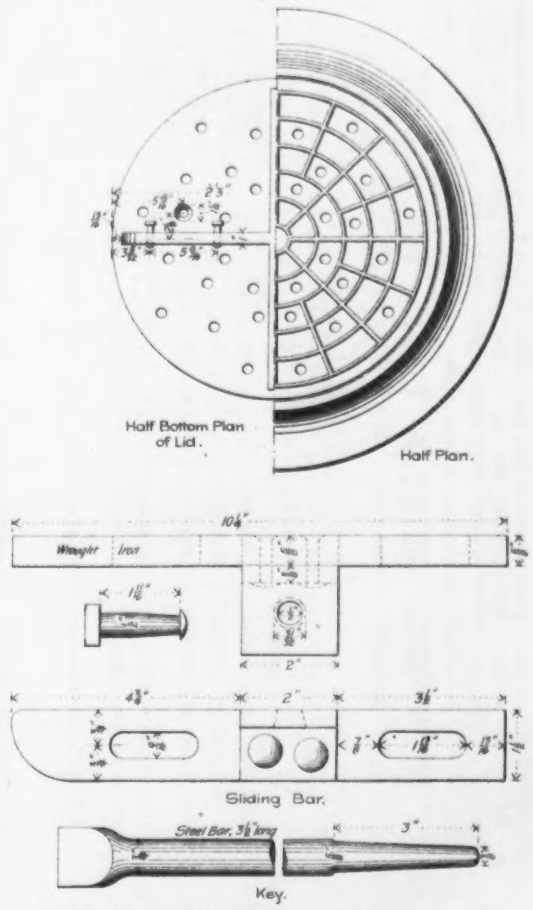
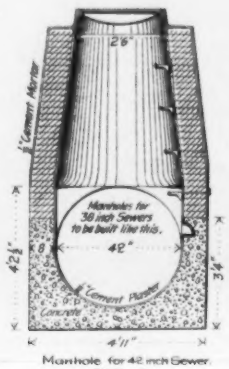
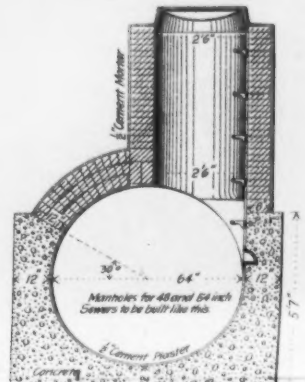


FIG. 7. MANHOLE COVER AND LOCKING DEVICE.



Manhole for 42 inch Sewer.

FIG. 5.



and ordinary barometric pressure, the permanent gases generated by gunpowder occupy about 280 times the volume of the original powder. The temperature of the explosion of gunpowder is about 2,000° Cent., or nearly 4,000° Fahr., and these gases consequently exert a tension, when developed is about 486 ft.-tons per pound of powder. The data are not yet sufficiently authentic upon which to base a similar statement regarding the explosive effect of dynamite or other high explosives. Dynamite is a mixture of nitro-glycerine with an inert absorbent, and consequently any consists of 554 parts water vapor, 469 parts carbonic acid, 236 parts of nitrogen and 39 oxygen. List estimates the bulk of the liberated gases at 1,504.9 volumes.

While nitro-glycerine evolves nearly six times as much gas as gunpowder, at 100° Cent., the far

THE NEW UNITED STATES NAVY.

Name.	Authorized.	Keel laid.	Builders; when built.	Condition; date of est. completion.	Displacement—tons.	Horse power—max. I.H.P.	Speed—Knots.	Dimensions. Length load water line. ft.	Extreme width. ft.	Mean draft. ft.	Batteries. Main.	Batteries. Secondary.	Cost. Hull and machinery contract.	Type of engines.
Class I.—Battle ships; sea going; coast line.***														
*Texas	1886	1889	U. S. Navy Yard, Norfolk, Va.	Building, June, 94.	6,300	8,000	17	301.3	64	22.5	2 12-in. B. L. R. 6 6-in. B. L. R.	12 6-pdr. R. F. 6 1-pdr. R. F. 4 Hotchkiss 2 Gatlings	$2,500,000	Twin screw, vertical triple expansion.
**Massachusetts	1890	1891	Cramp & Sons, Philadelphia, Pa.	Building, July, '94.	10,260	9,000	15	348	69.2	24	4 13-in. B. L. R. 8 8-in. B. L. R. 4 6-in. B. L. R.	20 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings	3,020,000	Ditto.
**Indiana	1890	1891	Cramp & Sons, Philadelphia, Pa.	Building, Feb. '94.	10,200	9,000	15	348	69.2	24	Ditto	Ditto	3,020,000	Ditto.
**Oregon	1890	1891	Union Iron Works, San Francisco.	Sept. 94.	10,200	9,000	15	348	69.2	24	Ditto	Ditto	3,180,000	Ditto.
*Iowa	1892	1893	Cramp & Sons, Philadelphia, Pa	Building, Oct. '95.	11,296	11,000	16	360	72.2	24	4 12-in. B. L. R. 8 8-in. B. L. R. 6 4-in. B. L. R.	20 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings.	3,010,000	Ditto.
Class II.—Coast defense; monitors; low free board.***														
*Puritan	1883	1875	John Roach, Chester, Pa.	Building, Jan., '94.	6,060	3,700	12.4	289.5	60.1	18	4 12-in. B. L. R. 6 4-in. R. F.	4 3-pdr. R. F. 4 H. R. C. 4 Gatlings	.....	Twin screw, horizontal compound.
*Miantonomah.	1887	1874	Ditto	In service.	3,990	1,426	10.5	259.5	55.8	14.5	4 10-in. B. L. R.	2 6-pdr. R. F. 2 3-pdr. R. F. 1 1-pdr. R. F.	.....	Twin screw, inclined compound.
*Amphitrite	1887	1874	Harlan & Hollingsworth, Wilmington, Del.	Building. April, '94.	3,990	1,600	12.	259.5	55.8	14.5	4 10-in. B. L. R. 2 4-in. R. F.	2 6-pdr. R. F. 2 3-pdr. R. F. 2 H. R. C.	.....	Ditto.
*Monadnock	1887	1874	U. S. Navy Yard, Mare Island, Cal.	Building, 57% done.	3,990	3,000	14.5	259.5	55.8	14.5	4 10-in. B. L. R. 2 4-in. R. F.	2 6-pdr. R. F. 2 3 pdr. R. F. 2 H. R. C.	.....	Twin screw, horizontal triple expansion.
*Terror	1887	1874	Cramp & Sons, Philadelphia, Pa.	Building, Jan. '94.	3,990	1,600	12.	259.5	55.8	14.5	4 10-in. B. L. R.	2 6 pdr. R. F. 2 3-pdr. R. F. 2 H. R. C. 2 Gatlings.	.....	Twin screw, inclined compound.
*Monterey	1887	1889	Union Iron Works, San Francisco.	Service.	4,000	5,244	13.6	256	59	14.5	2 12-in. B. L. R. 2 10-in. B. L. R.	6 6-pdr. R. F. 4 1-pdr. R. F. 2 Gatlings.	$1,628,950	Twin screw, vertical triple expansion.
Class III.—Steel-armored cruisers.														
Maine	1887	1888	U. S. Navy Yard, Brooklyn, N. Y.	Building, April, '94.	6,648	9,000	17	318	57	21.5	4 10-in. B. L. R. 6 6-in. B. L. R.	8 6-pdr. R. F. 8 1-pdr. R. F. 4 Gatlings.	$2,500,000	Twin screw, vertical triple expansion.
New York	1888	1890	Cramp & Sons, Philadelphia, Pa.	Service.	8,480	17,401	21	380.5	64.8	23.9	6 8-in. B. L. R. 12 4-in. R. F.	8 6-pdr. R. F. 4 1-pdr. R. F. 4 Gatlings.	2,985,000	Ditto.
Brooklyn	1892	1893	Cramp & Sons, Philadelphia, Pa.	Building, Feb. '95.	9,153	16,000	20	400.5	64	24	8 8-in. B. L. R. 12 5-in. R. F.	12 6-pdr. R. F. 4 1-pdr. R. F. 4 Gatlings.	2,986,000	Ditto.
Class IV.—Protected Cruisers.														
Chicago	1883	1883	John Roach, Chester, Pa.	Service.	4,500	5,084	15.3	325.	48.1	19.	4 8-in. B. L. R. 8 6-in. B. L. R. 2 5-in. B. L. R.	9 6 pdr. R. F. 4 1-pdr. R. F. 2 H. R. C. 2 Gatlings.	$899,000	Twin screw, compound, overhead beam.
Boston	1883	1883	Ditto	Service.	3,189	4,030	15.6	270.2	42.	17.	6 6-in. B. L. R. 2 8-in. B. L. R.	2 6-pdr. R. F. 2 3-pdr. R. F. 2 1-pdr. R. F. 4 H. R. C. 2 Gatlings.	619,000	Single screw, horizontal compound.
Atlanta	1883	1883	Ditto	Service.	3,189	4,030	15.6	270.2	42.	17.	Ditto.	Ditto.	617,000	Ditto.
Newark	1885	1887	Cramp & Sons, Phila., Pa	Service.	4,083	8,869	19.	310.	49 1	18.9	12 6-in. B. L. R.	4 6-pdr. R. F. 4 3-pdr. R. F. 2 1-pdr. R. F. 3 H. R. C. 4 Gatlings.	1,248,000	Twin screw, horizontal, triple expansion.
Charleston	1885	1887	Union Iron W'ks, San Fr'isco	Service.	4,040	6,666	18.2	312.	46.	19.7	2 8-in. B. L. R. 6 6-in. B. L. R.	4 6-pdr. R. F. 2 3-pdr. R. F. 2 1-pdr. R. F. 4 H. R. C. 2 Gatlings.	1,017,000	Twin screw, horizontal compound.
Baltimore	1886	1887	Cramp & Sons, Phila., Pa.	Service.	4,600	10,061	19.6	327.5	48.5	20.5	4 8-in. B. L. R. 6 6-in. B. L. R.	4 6-pdr. R. F. 2 3-pdr. R. F. 2 1-pdr. R. F. 4 H. R. C. 2 Gatlings.	1,325,000	Twin screw, horizontal triple expansion.
San Francisco	1887	1888	Union Ir. W'ks, San Fr'cisco.	Service.	4,083	10,400	20.2	310.	49.1	18.7	12 6-in. B. L. R.	4 6-pdr. R. F. 4 3-pdr. R. F. 2 1-pdr. R. F. 3 H. R. C. 4 Gatlings.	1,428,000	Ditto.
Philadelphia	1887	1888	Cramp & Sons, Phila., Pa.	Service.	4,324	8,815	19.7	327.5	48.5	19.2	12 6-in. B. L. R.	Ditto.	1,325,000	Ditto.
Olympia	1893	1890	Union Ir. W'ks, San Fr'cisco.	Service.	5,500	13,500	20.0	340.	53.	21.5	10 5-in. R. F. 4 8-in. B. L. R.	14 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings.	1,796,000	Twin screw, vertical triple expansion.
Cincinnati.	1888	1890	U. S. Navy Y'd, Br'klyn, N.Y.	Building.	3,183	10,000	19.0	300.	42.	18.	10 5-in. R. F. 1 6-in. R. F.	8 6 pdr. R. F. 4 1-pdr. R. F. 2 Gatlings.	1,100,000	Ditto.
Raleigh	1888	1889	U. S. Navy Yard, Norf., Va.	Service.	3,183	10,000	19.0	300.	42.	18.	Ditto.	Ditto.	1,100,000	Ditto.
Columbia.	1890	1890	Cramp & Sons, Phila., Pa.	Service.	7,350	21,000	21.	412.	58.	22.5	1 8-in. B. L. R. 2 6-in. R. F. 8 4-in. R. F.	12 6-pdr. R. F. 4 1-pdr. R. F. 4 Gatlings.	2,725,000	Triple screw, vertical triple expansion.
Minneapolis	1891	1891	Ditto	Building, July, '94.	7,350	21,000	21.	412.	58.	22.5	Ditto.	Ditto.	2,690,000	Ditto.
Class V.—Cruisers.														
Montgomery	1883	1890	Columb'n Ir. W'ks, Balt., Md.	Service.	2,000	5,400	17.	257.	37.	14.5	8 5-in. R. F. 2 6-in. R. F.	6 6-pdr. R. F. 2 1-pdr. R. F. 2 Gatlings.	$612,500	Twin screw, vertical triple expansion.
Detroit	1893	1890	Ditto	Service.	2,068	5,227	18.7	257.	37.	14.7	Ditto.	Ditto.	612,500	Ditto.
Marblehead	1888	1890	City Pt. W'ks, Boston, Mass.	Service.	2,000	5,400	17.	257.	37.	14.5	Ditto.	Ditto.	674,000	Ditto.

in a confined space, which amounts to 6,400 atmospheres, or about 42 tons per sq. in., if the powder entirely fills the space on which it is exploded. The total theoretic work which gunpowder is capable of performing in expanding indefinitely such statement must relate to the nitro-glycerine in the dynamite and not to the compound itself. Noble estimates that one volume of nitro-glycerine disengages 1,298 volumes of gases of 100° Cent. at a barometric pressure of 760 mm. It then higher degree of heat produced by the instantaneous combustion of nitro-glycerine, according to Noble, expands the bulk of the freed gases to eight times the original 1,298 volumes. The gases of gunpowder would only be trebled at a like temperat

ture. The explosive force of nitro-glycerine then stands in relation to that of gunpowder as 13 to 1, according to volume.

The remainder of the paper was devoted to a detail of personal experience, and that of others, in blasting with high explosives. The chief point of interest in these is the deduced duty per pound of explosion. Mr. Nursey says that as the result of his own experience, verified by the experience of others, the average work done with dynamite is from 3 to 3½ tons of rock removed per pound of explosive employed, under reasonable and fairly favorable conditions.

THE NEW NAVY OF THE UNITED STATES.

The formation and progress of the new navy of the United States give rise to items of almost daily occurrence in the press of the country; but unfortunately these items are often very inaccurate in classification, dimensions, battery, etc., and the full list of the new ships is not generally accessible. For these reasons the following table has been prepared from material furnished us by Mr. Philip Hichborn, Chief Constructor U. S. N. and Chief of the Bureau of Construction and Repairs. We have arranged the ships under nine class headings for the purpose of more ready comparison of dates, dimensions and cost.

We have omitted in the large table the thickness of armor used on the battleships, coast defense monitors and armored cruisers, but we add this item of information as below:

Name.	Thickness of armor on—Sides, ins.	Turrets, ins.	Barbetts, ins.
Iowa	3—14	5½—15	6—8—15
Texas	12	12	.....
Massachusetts	18	6—18	6—8—17
Indiana	18	6—18	6—8—17
Oregon	18	6—18	6—8—17
Puritan	14	8	14
Miantonomah	7	11½	.....
Amphitrite	9	7½	11½
Monadnock	9	7½	11½
Terror	7	11½	.....
Monterey	13	7½—8	11½—14
Maine	12	8	12
New York	4	5½	10
Brooklyn	.....	5½	4 —
Katahdin	6	.....	.....

In the list of armored ships the names of 13 single-turreted monitors are purposely omitted though they still appear upon the navy list, and are now lying in ordinary at the various navy yards. They are almost identical in type, and the following description of the historic "Manhattan" is given as in interesting contrast to the ships of the new navy: Length, 225 ft.; breadth, 43.6 ft.; mean draft, 13.5 ft.; displacement, 2,100 tons; indicated horse power, 340. The engines were all of the single-screw, grasshopper type, giving a speed of from five to six miles per hour. The main battery was made up of two 15-in. smooth-bore guns, and there was no secondary battery. The sides were protected by 5-in. plate and the turret by 10-in. armor plate. The cost of the "Manhattan" in 1862 was $628,879.27.

The class names sufficiently indicate the character of each warship when taken in connection with the detail of her size, power and armament as given in the list. In the item of battery the contraction "B. L. R." stands for breechloading rifle, and "R. F." means rapid-fire gun. The prices given are either the contract prices or the limit of cost fixed for government work.

THE NEW UNITED STATES NAVY (Continued).

Name.	Authorized.	Keel laid.	Builders; when built.	Condition; est. date of completion.	Displacement—tons.	Horse power—max. I.H.P.	Speed—knots.	Dimensions. Length load wat'r line, ft.	Dimensions. Extreme width, ft.	Dimensions. Mean draft, ft.	Batteries. Main.	Batteries. Secondary.	Cost, Hull and machinery contract.	Type of engines.
Class VI.—Gunboats.														
Petrel	1885	1887	Columbian Iron Works, Baltimore, Md	Service	890	1,513	11.5	176.2	31	11.6	4 6-in. B. L. R.	2 3 pdr. R. F.; 1 1-pdr. R. F.; 2 H. R. C.; 2 Gatlings	$247,000	Single screw, horizontal compound.
Yorktown	1885	1887	Cramp & Sons, Philadelphia, Pa	Service	1,700	3,600	16.6	230	36	14	6 6-in. B. L. R.	2 6-pdr. R. F.; 2 3-pdr. R. F.; 1 1-pdr. R. F.; 2 H. R. C.; 2 Gatlings	455,000	Twin screw, horizontal triple expansion.
Concord	1887	1888	N. F. Palmer & Co., Chester, Pa	Service	1,700	3,405	16.8	230	36	14	Ditto	ditto	490,000	Ditto.
Bennington	1887	1888	Ditto	Service	1,700	3,436	17.5	230	36	14	Ditto	ditto	490,000	Ditto.
Machias	1889	1891	Bath Iron Works, Bath, Me.	Service	1,067	1,700	15.5	190	32	12	8 4-in. R. F.	4 6-pdr. R. F.; 2 1-pdr. R. F.; 2 Gatlings	318,000	Twin screw, vertical triple expansion.
Castine	1889	1891	Ditto	Service	1,067	2,186	16	190	32	12	Ditto	Ditto	318,000	Ditto.
Class VII.—Light Draft Gunboats.														
No. 7*	1893				1,261	1,750	14	220	36	11	8 4-in. R. F.; 1 torpedo tube	4 6-pdr. R. F.; 2 1-pdr. R. F.; 2 Gatlings	.....	Twin screw, vertical quadruple expansion.
No. 8	1893				1,313	1,600	13	250.5	40	8.8	8 4-in. R. F.	Ditto	.....	Twin screw, vert. triple exp'n.
No. 9	189				1,313	1,600	13	250.5	40	8.8	Ditto	Ditto	.....	Ditto.
Class VIII.—Special.														
Katahdin—Lar bor ram	1889	1891	Bath Iron Works, Bath, Me.	Building	2,183	4,800	17	250.7	43.4	15	0	4 6-pdr. R. F.	$930,000	Twin screw, vert. triple exp'n.
Vesuvius — dynamite	1887	1887	Cramp & Sons, Philadelphia, Pa	Service	930	3,794	22 5	251.7	26.4	10.6	3 15-in. dynamite guns.	3 3-pdr. R. F.	350,000	Ditto,
Dolphin — dispatch boat	1883	1883	John Roach, Chester, Pa	Service	1,485	2,240	15.5	240	32	14.3	2 4-in. R. F.	2 6-pdr. R. F.; 2 H. R. C.; 2 Gatlings	315,000	Single screw, vertical compound.
Bancroft — for cadets	1888	1891	Moore & Sons, Elizabethport, N. J	Service	832	1,213	14.4	187.5	32	11.5	4 4-in. R. F.	2 6-pdr. R. F.; 2 3 pdr. R. F.; 1 1-pdr. R. F.; 1 H. R. C.; 1 Gatling	250,000	Twin screw, vertical triple expansion.
Class IX.—Torpedo boats.														
Stiletto—wood			Herreschoff Man. Co., Bristol, R. I	Service	31	359	18.2	88.5	11	3	0	0	$25,000	Single screw, vertical
Cushing—steel	1887	1889	Ditto	Service	116	1,720	22.5	138.7	14 8	5.2	3 torpedo tubes	3 1 pdr. R. F.	82,750	Twin screw, vertical quadruple expansion.
Ericsson — steel	1890	1892	Iowa Iron Works, Dubuque, Ia	Building	120	1,800	24	150	15.5	4.7	3 18-in. torpedo tubes—Whitehead	4 1-pdr. R. F.	113,500	Ditto.

* Contracts for these ships were opened on Oct. 17. The Newport News Shipbuilding Company was the lowest bidder, at $290,000 for No. 7, and $313,000 for either No. 8 or 9; $575,000 for both Nos. 8 and 9, or $8[illegible],000 for all three.

RECLAMATION OF THE POTOMAC FLATS AT WASHINGTON, D. C.*

The Potomac River from Little Falls to its mouth is at tidal stream, the tidal range at Washington being 3 ft., and at its mouth 1½ ft. There is a good channel all the way to Washington, which is rather shoal in a few places and is bordered on the sides with large areas of flats or marshes. From the earliest times there have been always two channels in the harbor of Washington and sometimes three. The Virginia Channel is the widest and deepest, passing between the Virginia shore and the Analostan Island. In 1806 this was closed by a dam between the island and the shore, and was forced over to the Georgetown side, forming the Georgetown Channel. The island thus became a training dike, but was not long enough. The shoal place remained shoal, and a large area of flats was created below the island. The second or "swash" channel had a depth of about 6 ft. at low tide, but is now almost obliterated. The third or Washington Channel at one time had a depth of nearly 3 ft., but is now almost entirely filled up. The same causes that produced the shoaling of the channels also formed the Potomac Flats at Easby's Point. At their upper limit the river is about 900 ft. wide, while immediately below, it is about 5,000 to 6,000 ft. This sudden expansion in width causes a deposit of silt in times of freshets, filling the channel to some extent, but filling still more the eddies and dead water behind Easby's Point. This filling up requires frequent dredging of the channels to maintain the requisite depth for commerce. The Potomac Flats have continued to increase until they have become a nuisance, which has been aggrevated by the discharge of a large amount of sewage upon them the stench from which is at times almost intolerable. A change in the disposal of the sewage would only lessen, but not cure the evil. The question was, Should the flats be filled up above the level of overflow, or dug out so as to form a large area of deep water, or should they be diked in and pumped out. Various plans have been proposed at different times.

In 1882, Mr. S. T. Abert, M. Am. Soc. C. E., proposed to fill the flats to a level of 6 ft. above low tide and protect it from overflow by an embankment. In 1882 a board of engineers consisting of Lieut.-Cols. Gillmore, Craighill and Comstock, of the Corps of Engineers, submitted a plan combining the harbor and shore lines and the low-grade filling and surrounding embankment of Mr. Abert's plan with the high-grade filling and sluicing ponds proposed by Mr. Twining in 1879. The board regarded the rebuilding of Long Bridge with wider spans and piers offering less obstruction to the flow of water as essential. This plan was adopted by Congress and has been nearly carried out. The low-grade filling below Long Bridge was modified in 1887 to a fill 3 ft. above the freshet line, along the axis of this area, sloping off to about 6 ft. at low tide, the margin on either side. For the flushing ponds a single lake or reservoir was substituted. The total area of flats reclaimed is about 625 acres, requiring about 12,000,000 cu. yds. of material. The law contemplated the taking of the greater part of the material required from the bed of the river.

The first contract made was for dredging the channel to 20 ft. depth and 400 ft. width. The plan was to dredge the material in the ordinary way, and convey it in bottom dumping scows to a receiving basin, where it was to be discharged, and again taken up

* Abstract of a paper by Lt.-Col. Peter C. Hains, U. S. Engineer Corps, read before the American Society of Civil Engineers, Dec. 20, 1893.

by a dredge and deposited in cars and hauled to the dumping ground by a locomotive. This necessitated the handling of the material twice, and the construction of a long line of trestlework which soon became useless. The trestle was built on piles mostly 60 to 70 ft. long, cut off at about 10 ft. above the surface of the flats and capped with timbers. On these caps longitudinal timbers were laid and on the latter the rails. The cars were double side-dumpers, holding 10 cu. yds. each, and were hauled out in trains of ten cars each, the contents being all dumped at one time. For putting the material on the flats above Long Bridge 13,000 lin. ft. of trestle was constructed, and there were deposited on this section about 863,000 cu. yds., giving only about 66 cu. yds. per lin. ft. of track built. To facilitate loading, the tracks at the receiving basin were only 4 ft. above low tide, rising by a grade to 12 ft. Below Long Bridge the single line was mostly 12 ft. above the flats, and 557,000 cu. yds. were dumped from 7,400 ft. of trestle; this gave about 75 cu. yds. per lin. ft. About 120 acres were thus covered by deposits to a depth of about 6 ft. above mean low tide. The trestle cost $30,000, or at the rate of 2 cts. per cu. yd. of material handled. After dumping from the cars the material had to be leveled off by means of a Worthington force pump. By means of this water was forced through a 4-in. wrought iron pipe with a hose and nozzle attached, but the method was not satisfactory. The material was dredged from an average depth of 18 ft. below mean tide and raised by the first operation 8 ft. above tide or 26 ft. in all. It was then towed to the receiving basin, dropped, again picked up and raised 28 ft. and loaded into cars. The rise of the grade of the tracks made a still further increase of 6 ft. or a total lift of 60 ft.; whereas, the average difference in level between the material in the river and on the flats was only about 21 ft. The price paid was 21.2 cts. per cu. yd. (scow measurement), which included all the profits to the contractor.

At the same time the construction of embankments was begun along the margin. These were formed in water 2 to 4 ft. deep at low tide. The material was mostly soft alluvium with some sand. The embankments were made as follows: An ordinary light draft clamshell dredge would make a cut 6 ft. deep at mean low tide and wide enough to enable her to work conveniently, depositing the spoil on the side toward the proposed fill. Where the water was deep a second cut would be made widening the trench. Stone was then thrown into the trench, forming a ridge 9 ft. high, with slopes of 1 on 1. The trench was then further widened and deepened by a dredge with a longer boom or with a chute carried on a scow. An endless chain dredge was used after the first cut was made, by which the material was lifted to a height of about 12 ft. and dropped into a hopper, from which it was fed to a conveyor and carried to a place of deposit. This conveyor was a line of little cars forming the links of an endless chain, supported on a frame built on scows moored alongside the dredge. By this means the embankments were raised 12 to 15 ft. above low tide. Where the chute was used the material was softened by handling, and, aided by a stream of water, would run 200 or 300 ft. beyond the end of it, thus giving a very flat slope to the embankment.

This work extended over a period of seven or eight years, and about 8½ miles of embankment were thus formed. Time had to be allowed where the material was soft for it to harden, and in such cases the work progressed very slowly. The stone in the trench formed a footing for the embankment and a foundation for the dry wall that was afterwards constructed. This wall from low-water level was 6 ft. high, 6 ft. wide at the base, 3 ft. wide at the top, with the back vertical, and cost $1.70 for the stone and $1.45 for the labor per cu. yd., or a total of about $2.80 per lin. ft. of wall.

The hydraulic dredges used on the Potomac excavated the material from the bed of the river and deposited it at the desired place on the shore with one operation. The machine consisted of a large rotary pump mounted on a scow, from which a cast iron pipe was led to the bottom of the river. The part leading into the water could be moved about a center from one side to the other, and the end of the pipe thus described the arc of a semicircle about 60 ft. diameter. The pipe was made with flexible joints and was carried on pontoons to the shore. The rubber joints were a source of much expense. Under favorable circumstances 30 to 40% of the volume pumped would be solid matter; but such large quantities did not give good results; as a rule, 10 to 20% was easily handled, with the engines making 125 revolutions per minute. Working in soft material one dredge averaged 350 cu. yds. per hour for days, the length of the discharge pipe being 3,000 ft. and the height above water level 6 to 12 ft. On one occasion 800 cu. yds. per hour were deposited at a height of 10 ft. above mean low tide and at a distance of 1,200 ft.

Clay, in passing through the pipes, would take the shape of balls about 5 ins. in diameter and boulders as large as a man's head have been forced through. A certain amount of sand and gravel could be handled, when mixed with mud or clay, but pure clay could not be handled with advantage, as it cut away the shell of the pumps very rapidly. In sand the discharge pipes were also apt to fill up so as to largely reduce their capacity. On one occasion the sand in the pipes was packed so hard that forcing the water through them for two days did not clear them. The water flowing through the discharge pipe at ordinary times had a velocity of about 10 to 15 ft. per second. By this method about 5,000,000 cu. yds. of material have been dredged and deposited on the flats at a cost of from 12.37 cts. to 15.45 cts. per cu. yd. The cost of excavation by the use of the Riker pump was about 13 to 14½ cts. per cu. yd.

The total amount of material deposited on the flats up to Jan. 1, 1893, was 9,437,523 cu. yds. Converting place measurement into scow measurement on the basis of 20% excess, the average price for the whole work done would be 11½ cts., including the profit of the contractor, or a little more than half the cost of the same work done by means of scows and railroads on trestles. The filling of marshes in proximity to cities will often pay the cost from the enhanced value of the land created and is usually desirable from a sanitary point of view, and the hydraulic method is in many places an economical one. It is found on the Potomac flats that the settlement in material was very small where there was a moderate quantity of sand in it; but where it was pure mud it was considerable and long continued, amounting in three years to 2 or 3 ft., and in seven years more to 14 ft. additional.

According to the plans adopted the Washington channel will be closed at the upper end and become an arm of the river, in which the tides would rise and fall, but with no tendency to clear itself. With a view, therefore, of clearing it from pollution of sewage, etc., a large reservoir was designed to receive water on the flood tide from the Virginia channel and discharge it into the head of the Washington channel at the ebb. The area of the reservoir, as laid out, was 111 acres, with a depth of 8 ft. below low tide. The mean duration of flood tide is about 5½ hours and of ebb about 6¾ hours, and about 14,500,000 cu. ft. would be received on the average flood tide ,or 29,000,000 cu. ft. daily. After careful study it was decided that the inlet gate might be dispensed with, and an open connection made with the Virginia channel. It was hoped the flow of the river would keep the water level at the site of the inlet above that at the outlet, and experience has justified this.

The mud at the outlet has a depth of about 75 ft. below tide. The structure for the outlet gate was built upon a pile and grillage foundation, the piles being spaced so as to receive a weight of about 10 tons each. The structure consists of a dam of masonry, with six arched openings, connected to the adjacent fill on either side by wing walls. The head walls are built of granite and the wing walls of concrete; the openings are 6 ft. wide and 12½ ft. high to the crown of the arch. The gates are in pairs, pivoted on vertical axes and swinging, while open, into recesses in the side walls. They butt, when closed, like the gates of a canal lock, on miters at the bottom and top and move easily on the slightest pressure. They close automatically when the tide begins to rise at the head of the channel, shutting off the passage of the water into the reservoir, and as soon as the tide begins to fall they open and allow the water to flow from the reservoir to the Washington channel.

A RENEWABLE SEAT GATE VALVE.

The superiority of gate valves to globe valves in any system of piping where it is an object to reduce the resistance to the flow of fluid in the

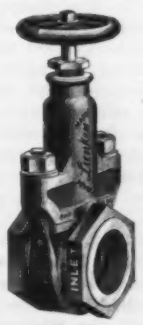


Fig. 1.

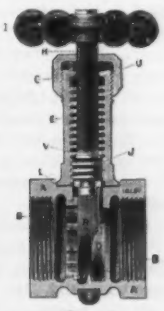


Fig. 2.

pipe, has long been known; but it is only recently that it is coming to be generally appreciated by users of valves. The simplicity of globe valves, and the convenience with which the seat may be refaced or renewed in case of injury, have had much to do with their popularity, and many efforts have been made to design gate valves which could be repaired with similar ease.

We illustrate herewith a new style of gate valve with a renewable seat and with other novelties in design which promise excellent results in practice. Fig. 1 is a perspective view of the valve, and Fig. 2 is a vertical section. The bonnet of the valve is made entirely separate from the body and is attached to it by a steel U-bolt, which passes entirely around the valve body, as seen in Fig. 1. The joint between the bonnet and the body is packed by a hard lead washer and the valve can be easily taken apart without injurying the washer so as to require its renewal. The bonnet is flat and narrow, with just enough space inside to permit the valve disk to rise and give the full diameter of the opening. On the flat sides of the bonnet are sectional or part threads, with which the thread on the valve stem engages.

Referring to Fig. 2, the valve disk has a straight flat bearing against the renewable seat C and is forced tightly against it by the self-adjusting half-ring wedge D secured loosely in the valve shell. The wedging on the disk is thus applied on wedging surfaces diametrically opposite each other; thus the wedging pressure is properly equalized on the entire disk and a tight joint on the opposite face is insured. The pressure of the steam or liquid on the back or wedge side of disk also aids to make a tight-closing valve.

Fig. 3.

Fig. 3 shows a perspective view of the renewable seat. A special spanner is furnished by which this seat may be put in place or removed in a few moments and without taking off the valve or in any way disturbing its connection with the pipes. In valves with iron bodies the renewable seat C screws into a second brass ring permanently fastened in the iron shell. This is to prevent the seat piece from rusting fast in place and giving trouble to remove. Fig. 4 shows the method of inserting and screwing in a new seat. The seat piece is a flanged ring with exterior threads and interior lugs with which the spanner engages. To start the seat true it is held on the ring end of the spanner and the milled edge is

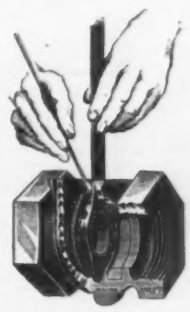


Fig. 4.

Fig. 5,

turned with any pointed tool until the threads engage. The other end of the spanner is then inserted to screw it home.

Another important feature of this valve is the provision of an automatic by-pass (forming part of all valves above 2½ ins. in size), by which the pressure on the two sides of the disk are equalized, or partially equalized, before the valve disk moves on its seat. Thus the most prolific source of the wear and cutting of the seat is eliminated and the valve opens very easily and with little strain and wear on the threads. Fig. 5 shows the opening in the disk which constitutes the by-pass. When the valve is shut, the end of the valve stem closes this by-pass opening, but the first one-sixth turn of the valve wheel opens it to its full width, and permits equalization of pressures on the two sides of the disk.

Another important feature of this valve is that when it is wide open a collar (V, Fig. 2) at the top of the threaded portion of the stem seats against a ring U at the top of the bonnet, thus taking the pressure of the stuffing box, preventing leakage through it, and permitting it to be repacked when the valve is under pressure. Among other claims for this valve are that the shell is so short and rigid and the wedging surfaces so small, that the disk is not likely to be stuck fast by un-

equal expansion and contraction. It is impossible for anything to lodge on the seat of the valve and interfere with its tight-closing, because the disk and the seat have straight parallel faces. As the pressure on the back of the disk keeps it tightly pressed against its seat, it actually cuts away (like the action of the blades of a pair of shears) anything in its path. This feature, combined with the renewable seat, makes the valve especially suitable for blow-off purposes. Every valve is warranted to stand a working pressure of 150 lbs. per sq. in. The manufacturers of these valves are the Lunkenheimer Co., of Cincinnati, O.

WATER PURIFICATION IN AMERICA.

(Continued from Vol. XXX., p. 449.)

The Warren Mechanical Filter.

Mechanical filtration is a somewhat broad term used to denote those systems of water purification in which an exceedingly rapid rate of filtration is made possible by means of mechanical devices for frequent quick and thorough washings of the filtering material without removing it from the filter.

The Warren gravity mechanical filter was patented in 1885 by Mr. John E. Warren, agent for S. D. Warren & Co., paper manufacturers, of Cumberland Mills, Me. The first plant was erected in the company's mills in 1886 and had a daily capacity of 12,000,000 gallons. Until the spring of 1893, so far as can be learned, this was the largest mechanical filtration plant in the United States, if not in the world, and it appears that it is still the largest industrial plant.

In 1887 plants were built for the public water supplies of Augusta and Brunswick, and in the last four years for a number of cities, as shown in the accompanying table, while a large number of paper and pulp mill plants, with an aggregate capacity of about 60,000,000 gallons, and some other industrial plants, have been built since the system was invented. The patent secured in 1885 covers the combination of a filtering apparatus containing a false bottom for supporting the filtering material and a toothed agitator, vertically adjustable, and the same in combination with a plunger for giving the agitator its adjustment and rotation. The agitator is designed to loosen the sand in washing.*

the filter plants included in the table has been secured. Most of the information relates more especially to the general features and the operation of the plants, some of which is embodied in the accompanying table; but the precipitating tank and filters at Athens, Ga., and the alum apparatus at Decatur, Ill., are described in detail, as representing the latest features of the system.

Before considering the several plants, some information may be given regarding the filtering material furnished by the company, which is selected sand of three grades of fineness from Lake Sebago, Me. The sand is dried in the sun during the summer and in pans over wood fires in the winter. A mechanical sifter, consisting of a revolving screen driven by a kerosene engine, separates the sand into three grades, air being forced through the screen to drive out the dust. The sand is shipped in bags of 1 cu. ft. capacity, about eight tons being required for a 10-ft. filter tank. The Lake Sebago sand contains a large proportion of white quartz, is quite angular, and appears to be well suited for a filtering material, but no mechanical analyses of it have yet been made. The

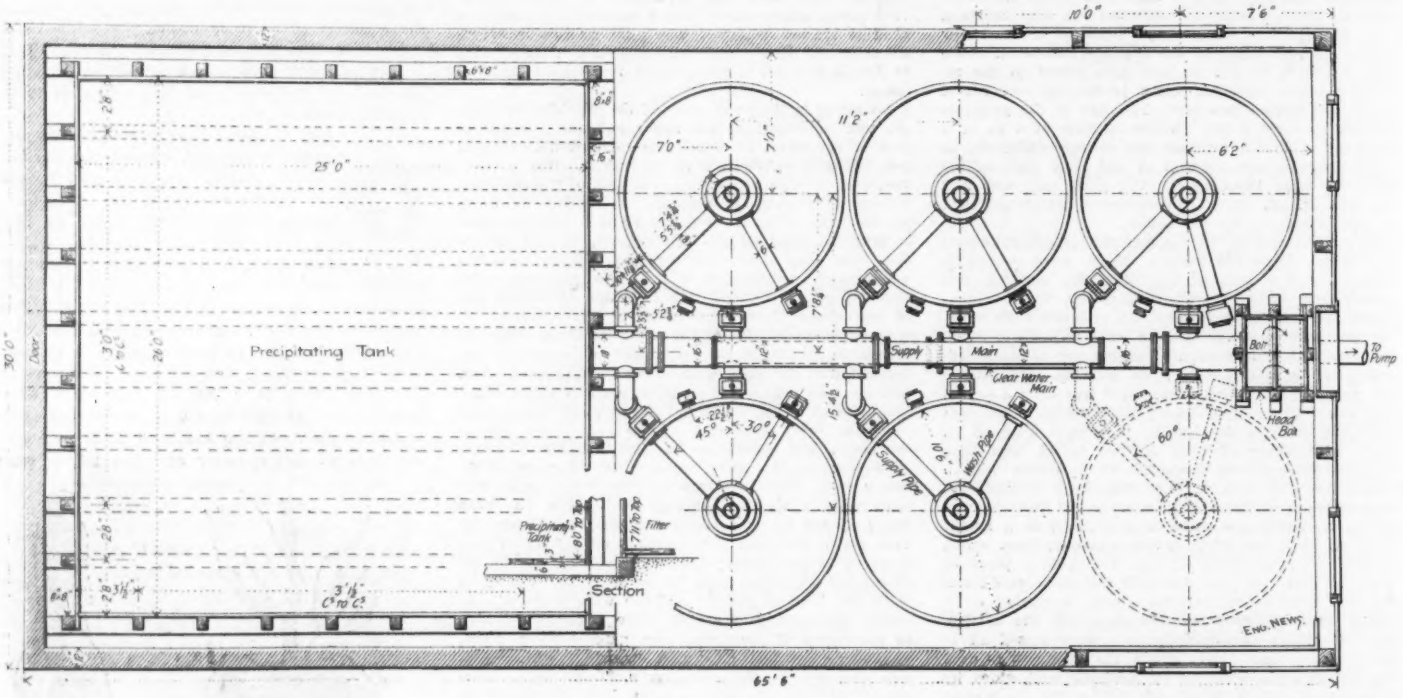


FIG. 7. PLAN OF WARREN FILTER PLANT AT ATHENS, GA.

This form of filtration is now generally supplemented by the use of some harmless chemical which acts as a coagulant and precipitant and is designed to assist in both the rapidity and efficiency of filtration. It is claimed that by means of frequent and perfect cleansing of the filtering material, together with the use of a coagulant, more perfect results may be obtained by this than by any other form of water purification, and at much less cost. Such claims can be discussed more satisfactorily after the various systems have been described, so it only needs to be said here that mechanical filtration has been rapidly and widely adopted in this country and has so many strong points that it deserves serious attention by all who are interested in water purification.

In general it may be stated that all forms of filtration on a large scale, mechanical or otherwise, have originated in an attempt to remove suspended matter from water. It has been afterward found that processes which were successful in this respect have also effected a more or less complete bacteriological purification at the same time. Therefore it is not at all strange that one of the best known and most successful systems of mechanical filtration, the Warren, should have been devised for the clarification of the water used in a large paper mill, where a high degree of clearness was essential.

In 1889 a patent was taken out for a central well containing the inlet and waste pipe, connecting gutters and a vertically moving shaft or agitator in connection therewith. This patent covers the filter proper as now made by the Cumberland Manufacturing Co., but in July, 1890, an important adjunct to the plant was patented by Prof. Henry Carmichael, of Malden, Mass., and assigned to the company. This pump was designed to remedy defects in that previously used by the company. The device invented by Professor Carmichael, and described further on, provided for the admission of a coagulant at a rate accurately and automatically regulated by the flow of unfiltered water. A prominent feature of the system, though not always used, is a preliminary settling tank, which becomes a precipitating tank when a coagulant is used.

The filters are manufactured by the Cumberland Mfg. Co., of 220 Devonshire St., Boston, Mass. Mr. John E. Warren, the inventor of the filter, is the president, and Mr. Walter B. Nye is the manager of the company. Through the kindness of Mr. Nye and of the officials of some of the waterworks concerned, the following matter regarding

* The filters built after this patent were fully illustrated and described in Engineering News of Nov. 19, 1887. The Cumberland Mills, Augusta and Brunswick plants are to be rebuilt in accordance with later improvements.

finest grade of sand is used for clayey waters, and the coarsest for those carrying vegetable matter, the latter water clogging the sand the quickest. With reasonable care in manipulation practically no sand is lost in washing.

Crushed white quartz has been tried by the company as a substitute for sand, but with no better results. The samples submitted have been offered at prices ranging from $10 up, but with the exception of Pontousic quartz, which costs $25, none of it is as even and regular in grain as the company's Lake Sebago sand. The only advantage of the white quartz would therefore be its greater popular attractiveness on account of its color.

Athens, Ga.—The filters at Athens are in connection with works built in 1893 by the city, which was previously supplied from works built in 1882-3 by a private company. The new works take their supply from the Oconee River, at a point about a mile from the center, but within the limits of the city, and above contamination. The river flows through a freestone and red clay country, and during the greater part of the year carries a large amount of red clay in suspension. The bulk of this clay is removed by simple sedimentation in a 12,000,000-gallon settling reservoir. It is to remove the balance of the suspended matter and at the same time effect such other purification as may be needed that the filters are used, the water sup-

plied to them being fairly constant in quality, although before sedimentation it is sometimes very muddy.

A sample of water from the river at the mouth of the intake, taken March 26, 1892, was analysed by Mr. H. C. White, and showed 52.53 parts per 100,000 of suspended matter. On standing 24 hours the most of the suspended matter settled. On adding ½ grain per gallon of potash alum to the water (probably the settled water), allowing it to stand ½ hour, and then passing it through filter paper the water was almost perfectly clear and upon analysis showed no albuminoid ammonia, and 0.003 parts per 100,000 of free ammonia. The original ammonias are not stated, but a sample taken a few days earlier, apparently from about the same source, after standing 24 hours, showed 0.004 part per 100,000 of albuminoid ammonia, and 0.001 part of free ammonia. The suspended matter in this sample was 11.35 parts per 100,000 before settlement and 7.49 parts after, a decrease of about 34% by simple sedimentation.

The water is taken from the river to a pump well through 500 ft. of 20-in. pipe. A centrifugal pump lifts the water to the large settling reservoir. The reservoir and pumping station are very near together and the filtering plant is adjacent to the pumping station.

The precipitating tank and filters at Athens are housed in a 30×63-ft. frame building, shown in plan and cross-section by Figs. 7 and 8. The tank is 25×26 ft., by 8 ft. deep, and has a capacity of about 39,000 gallons.

As the water enters the tank an alum pump delivers to it a fixed amount of alum in solution, as described in detail in connection with the Decatur plant. Some of the suspended matter is deposited in the tank before it passes to the filters.

A float valve connected with the pipe which supplies the tank maintains the water in the latter at a constant level. If the supply is cut off the water in the tank falls about 6 ins., to the level at which the pipe supplying the filters is generally placed.

It is claimed for the precipitating tank that it affords opportunity for chemical reaction between the coagulant and the bases in the water and for the heavier sediment and a portion of the coagulated matter to settle. The five filter tanks are each 10½ ft. in diameter and about 8 ft. deep, built of 3-in. long-leaf pine staves, shaped to a circle, and heavily hooped. The tanks are shown in plan in Fig. 7, in elevation and section by Fig. 8, and in perspective by Fig. 9.

A local coarse red sand is used, resting on a perforated copper bottom, supported as shown in Figs. 8 and 9.

The water enters the filter through the central inlet, and passes downward through the sand and the perforated bottom of the filter to the clear water compartment, from which it goes through the collecting main to a headbox or weir. This weir has its crest 20 ins. below the water level in the filters and precipitating tanks, and thus restricts the head to this amount.

To wash the filter the inlet and outlet valves are closed and the valve on the pipe connecting with the space surrounding the inlet pipe is opened. This allows the water in the tank to pass out, after which the revolving agitator, or rake, is set in motion and forced down into the bed by means of the driving apparatus shown in elevation in Fig. 8, and more plainly in the perspective view, Fig. 9. As the agitator moves through the sand, filtered water is allowed to flow back into the clear-water compartment and up through the sand to wash away the dirt from the loosened sand. When the wash water runs clear the agitator is withdrawn and filtration resumed.

The wash water is collected in the annular space surrounding the central inlet pipe, and also to some extent by the gathering pipes, which extend from this space to the pockets at the outer top edge of the filtering material, as shown in Figs. 8 and 9.

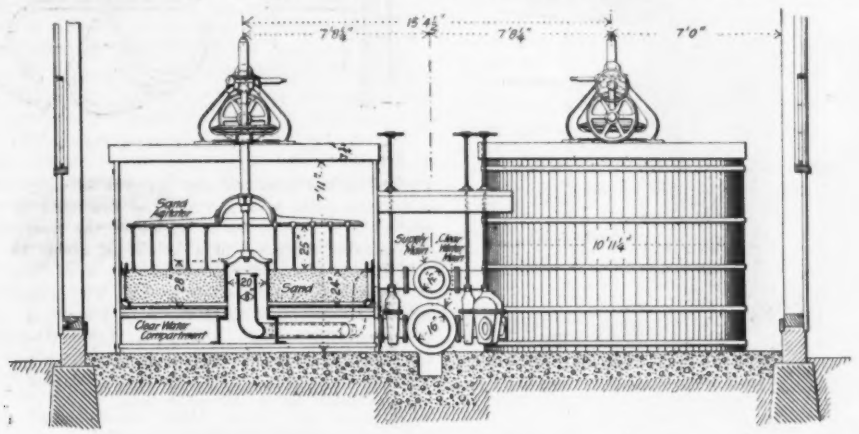


FIG. 8. SECTION AND ELEVATION OF ATHENS FILTERS.

A brick clear water basin 40 ft. in diameter and 20 ft. deep, giving an available capacity of about 185,000 gallons, is provided, and the filters are so operated as to keep this basin full. The basin is not covered. It is located in marshy ground, and has a bottom of concrete. There was so much seepage through the lower 5 ft. of the basin wall, which is 40 ins. thick, that no cement plastering could be kept in place, but the upper 15 ft. is plastered with Louisville cement.*

During the pumping test the filters were operated at the rate of 1,250,000 gallons, but the daily rate since September has been about 600,000 gallons.

Ammonia alum is used as a coagulant at an average rate of 0.5, a maximum of 0.7, and a minimum rate of 0.3 grain per gallon. The alum is bought of Harrison Brothers & Co., and costs 1.8 cts. per lb., delivered at the works. This is at the rate, on the average, of 71.4 lbs., or $1.29, per 1,000,000 gallons. Without the large settling reservoir more alum would be required.

The frequency of washing the filters depends, of course, upon the condition of the water, and the rate of filtration, and has varied from 5 to 8-hour intervals, or from 6 to 4 times per day, requiring from 2 to 5% of filtered water.

No special difficulties have been encountered in operating the plant, and there have been no complaints regarding the use of alum.

The filtering plant proper cost $7,175 without sand, and the building $1,850, making a total of $9,025. The clear-water reservoir cost an additional $2,600. The city wished an extra tank, so five instead of the usual four were put in. The settling reservoir was built under exceptional circumstances, at a reported cost of only $2,000, use being made of a railway embankment.

Unfortunately no chemical or biological examinations of the filtered water are available.

The information regarding the operation of the Athens plant, since put in use, was furnished by Prof. C. Morton Strahan, one of the water commissioners.

Decatur, Ill.—The alum apparatus used with the Warren filters is shown in Fig. 10, redrawn from a photograph of the Decatur plant, and in detail by Fig. 11. There are two alum pumps at Decatur, one of which is shown covered in the view.

A strong solution of alum is prepared in the upper or mixing tank, shown in Fig. 10, steam for mixing being admitted through a perforated lead tee. In the two lower tanks the solution is diluted to 3%, its strength being determined by urinometers, furnished with the alum apparatus, graded to indicate specific gravities ranging from 1.0 to 1.06. This solution is stirred, when necessary, with wooden paddles. A brass outlet pipe, a rubber valve and a rubber float are provided to draw the solution from the lower tank to the pump tank.

The pump is of rubber and has six ⅝-in. hollow rubber arms, as shown in Figs. 10 and 11, bending at the hub and passing along the pump axis to a deflecting cup, where the liquid is thrown down into the water as it enters the precipitating tank.

The pump is driven by a wheel, or eight-bladed propellor, placed in the supply main as it enters the precipitating tank. The speed of the wheel, and therefore of the pump, corresponds with the velocity of the incoming water, so that given a standard solution of the coagulant it is admitted in exact proportion to the amount of water being treated. By lowering the level of the solution in the pump tank, or by stopping up one or more of the arms of the pump with a soft rubber plug, the amount of coagulant used per gallon of water may be varied without changing the strength of the solution.

Aside from the information given in the table it may be stated that the Decatur water-works were built in 1871. The supply is from the Sangamon River, the daily pumpage being about 2,000,000 gallons. The water is said to be very muddy. The precipitating tank and filters are located on a hill some 80 ft. above the pumps, and the filtered water goes back to the high duty pumps under that head. The filters are washed about once in eight hours. There is a clear-water reservoir, uncovered, of about 1,500,000 gallons capacity.

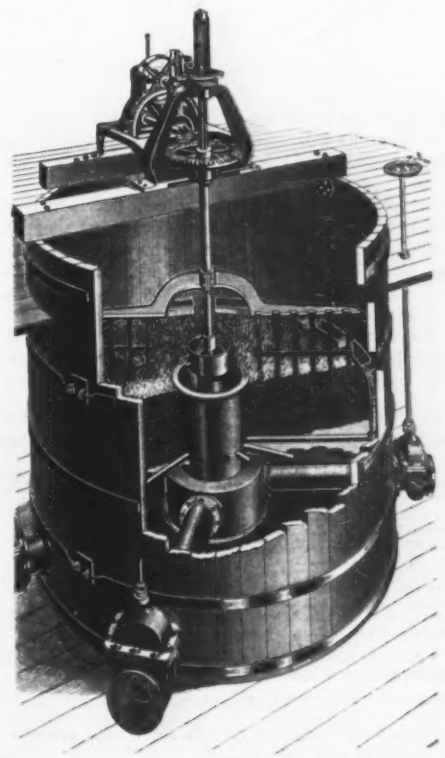


Fig. 9. View of Filter Showing Sand Agitator and Driving Machinery.

Oshkosh, Wis.—The water-works here were built by the Oshkosh Water Co., in 1884. The supply was formerly from artesian wells, but is now pumped from Lake Winnebago. The water contains so much vegetable matter as to give it a bad taste, odor and appearance. The average daily amount of water filtered during the past year was about 2,000,000 gallons, and the maximum was 2,946,000 gallons.

* For an interesting but brief account of the difficulties encountered in walling up this basin, which required a pile foundation, see an article by Mr. J. W. Barnett, City Engineer of Athens, the "Athens, Ga., Water Supply," in the "Engineering Society Annual" for 1893, of the University of Georgia.

The filters are in the pumping station, about 100 ft. from the lake, and necessitate extra pumping with an average lift of about 13 ft. This is effected by a Webber centrifugal pump, driven by a Westinghouse engine. The cost of this extra pumping for the last fiscal year was $1,200. When the water is particularly dirty the top of the sand quickly becomes covered, stopping the flow, but this is easily remedied by allowing the agitators to remain about 2 ins. deep in the sand, and revolving them a few times every 20 to 30 minutes. Not over one-fourth of the filtering material has been replaced during the three years it has been in use.

The cost of operating the filters, not including extra pumping, is stated as practically nothing by Mr. W. G. Maxey, Treasurer of the company, who has kindly given us information regarding this plant. See the accompanying table for other facts and figures.

The filtered water passes to a 500,000-gallon covered reservoir, originally used to store artesian well water, and protect it from the light. This reservoir is covered by a high roof, with screens for ventilation in each end. *

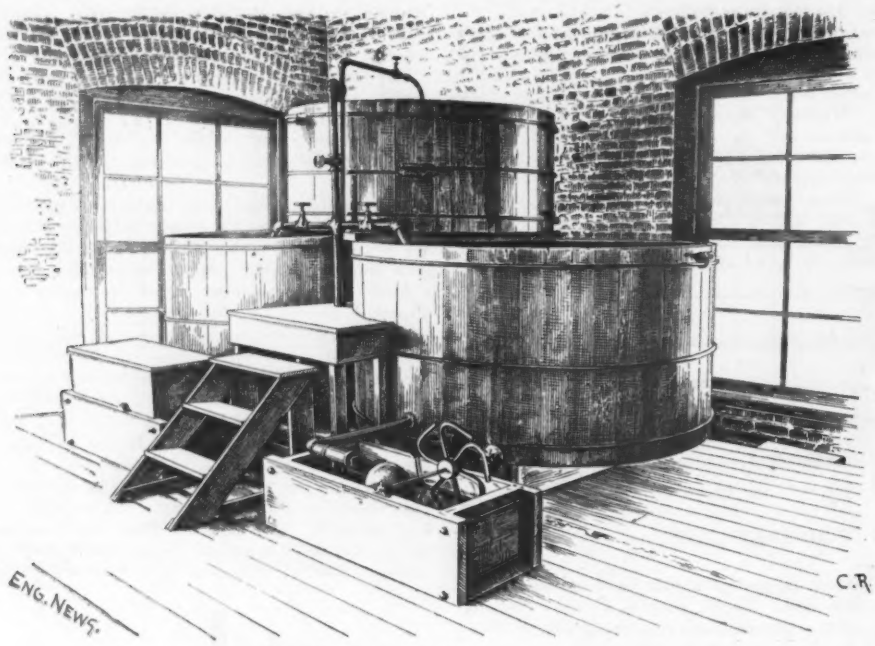


FIG. 10. ALUM TANKS AND AUTOMATIC PUMPS AT DECATUR, ILL.

Durham, N. C.—The plant at Durham was put in on account of the turbidity of the Eno River, from which water is pumped to a reservoir by water power, with steam power in reserve. This reservoir has an estimated capacity of 6,000,000 gallons, is some five miles from the town, and evidently serves as a settling reservoir for the water prior to filtration. For other information regarding the plant see the table.

An analysis of this water after filtration, and after passing from the reservoir, five miles distant, to a tap in Durham, was made at the North Carolina Agricultural Experiment Station, at Raleigh, and reported Oct. 3, 1893, by Mr. H. B. Battle, Director of the Station, as follows, the grains per gallon having been converted to parts per 100,000 for convenience:

Total solids in solution	7.2889
Carbonate of lime	2.1438
Chlorine	0.2744
Free ammonia	0.0070
Albuminoid ammonia	0.0111

So far as known, no analysis of the water before filtration has been made.

Macon, Ga.—Filtration at this place seems to be in a somewhat experimental state as yet, small plants representing three different systems having been secured from the manufacturers, and put up and operated by the water company, of which Mr. A. E. Boardman, of Macon, is president. These water-works were built in 1881 by the Macon Gaslight & Water Co. The supply is now pumped from the Ocomulgee River to a reservoir and tank. The water of the river is said to be so muddy as to make purification necessary before it can be used for household purposes. The finely divided clay and mica in the water make filtration somewhat difficult. The filters are on the bank of the river, about 25 ft. above low water, and necessitate extra pumping, with an average lift of about 30 ft.

Most of the information at hand regarding the Warren filters at Macon is given in the accompanying table. The amount of alum used in all the filters during the year for 270,028,000 gallons of water was 27,843 lbs., a little over 100 lbs. per 1,000,000 gallons, and between 0.7 and 0.8 grains per gallon. The maximum amount was 1.5, and the minimum 0.5 grains per gallon. The only complaint regarding the use of alum is reported to have been from a manufacturer of soda water. The alum is bought of Geisenheimer & Co., 189 Front Street, New York, and is said to be ordinary lump alum. An uncovered clear water reservoir with a capacity of 2,225,000 gallons is in use.

Augusta and Brunswick, Me.—These two plants need no description further than that given in the table.

Principal Features of Warren Filter Plants Connected with Public Water Supplies.

	Date put in use.	Cap. settling or precipating tank, galls.	Guaranteed capacity filters, galls. Total.	Per sq. ft.	Filtering material Kind.	Area, sq. ft.	D'p'th, ins.	Working b'd, ins.	Alum used.	Cost plant, excluding build'gs.
Augusta, Me.	1887	None	600,000	6,000	Fine gravel	100	18	24	No	.....
Brunswick, Me.*	1887	None	600,000	6,000	Fine sand	100	18	24	No	.....
Oshkosh, Wis.	Dec., '90	None	2,000,000	3,636	Fine sand	550	24	15	No	$20,000†
Macon, Ga.	Aug., '92	50,000‡	500,000	2,976	Coarse sand	168	24	20	Yes	.....
Calais, Me.	Jan., '93	.....	1,500,000	5,455	Coarse sand	275	20	20	No	.....
Durham, N. C.	Aug., '93	37,000	900,000	3,571	Coarse sand	252	26	20	Yes	$4,500
Athens, Ga.	Sept., '93	39,000	1,000,000	2,381	Coarse sand	420	24	20	Yes	7,175
Decatur, Ill.	Oct., '93	110,000	3,000,000	2,976	Coarse sand	1,008	24	20	Yes	19,000
Winfield, Kan.	1894	.....	1,000,000	.....	.....	.....	..	..	Yes	.....

* Not now in use, owing to abandonment of old source of supply. † Including extra pumping plant. ‡ Used in connection with other filters, regarding which see text.

The Oshkosh filters were illustrated and briefly described in Engineering News of Oct. 31, 1891.

Calais, Me.—The Calais Water Co., now controlled by the Maine Water Co., built works in 1886, taking a supply from the St. Croix River by gravity. The river carries a large amount of fine vegetable matter, sawdust and bark, it being used for logging and mill purposes. This matter could not be satisfactorily removed by screens, and

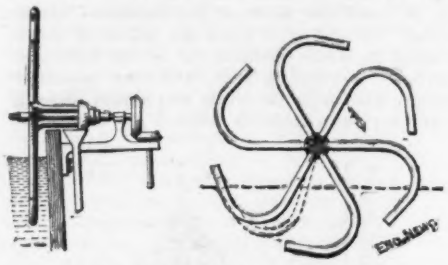


Fig. 11. Details of Alum Pump.

choked up the hydrants and services so badly that a filtering plant was provided, as described in the table. It is located on a branch of the river, and necessitates pumping to a height of about 18 ft.

Winfield, Kan.—The water-works were built in 1883 by the Winfield Water Co. The supply is pumped from the Walnut River to a reservoir 125 ft. above the main street. A 1,000,000-gallon Olyphant filter is reported as having been put in here in 1889, and the 1,000,000-gallon Warren filter will probably be in operation soon.

WATER BACTERIOLOGY AND SAND FILTRATION.

The importance of bacteriological studies of water supplies have been recognized by scientists for only a few years and it is only since the recent cholera scare that such studies have received much consideration in this country, except among the advanced students of sanitation. Some facts and reflections in this connection are given in "Longman's Magazine" for December, by Mrs. Percy Frankland, from which the following information has been taken:

For many years artificial sand filtration was considered by chemical experts as of no value, because it effected so little chemical change in the water. It was used to produce a clear rather than a pure water.

In 1885 the new bacteriological water tests of Dr. Koch were for the first time applied to the London water supply by Prof. Percy Frankland, resulting in the surprising demonstration that by sand filtration the number of bacteria in Thames River water were reduced 99.2%. Regular monthly examinations of the London supply were afterward made by Professor Frankland, which, with numerous studies elsewhere, have shown conclusively the value of sand filtration for the removal of bacteria from water.

It is interesting to note in connection with the London investigations that;

At the time when these results were first published, the public, instead of being reassured by these facts, were greatly alarmed, and it is a matter of history that the mere demonstration of the presence of micro-organisms in drinking water caused a fall in the price of several of the water companies' stocks!

Reference is made to the well known fact that Altona, with a filtered water supply, almost escaped the cholera epidemic which recently raged in the adjoining city of Hamburg, with an unfiltered supply from the same river.

Mrs. Frankland states that while there can no longer be any doubt of the value of sand filtration, "the slightest imperfection in its manipulation is a constant menace during any epidemic," a statement which is obviously just as true of any other form of water purification. Professor Frankland's London studies show that during the winter the unfiltered water is generally richest in bacterial life and that at the same time the largest number of bacteria are present in the filtered water, facts that demand great care in the winter management of filters.

In conclusion, Mrs. Frankland states:

The bacteriological methods for the examination of water, although when first introduced but a few years ago were lightly looked upon, and by many opposed,

have now become of paramount importance in all questions of water purification. The immense mass of evidence of a purely bacteriological character which was recently taken, and, indeed, required, by the Royal Commissioners on the London water supply, indicates clearly enough the change which has taken place in the public estimation of the value of these methods; and it is highly significant that in their report the commissioners lay stress upon the importance of extensive storage and efficient filtration, two facors the meaning and worth of which rest almost entirely on the results of bacteriological research.

PERSONALS

Mr. Henry D. Wood has been appointed City Engineer of Newton, Mass.

Mr. Thomas T. Johnston has been appointed acting Chief Engineer of the Sanitary District of Chicago.

Mr. John W. Sprague, for 13 years the Western manager of the Northern Pacific R. R., died recently.

Mr. Edward C. Lynde, for 25 years Secretary of the Lackawanna Iron & Steel Co., died at Scranton, Pa., Dec. 30.

Mr. Charles F. Mayer has been re-elected President of the Baltimore & Ohio R. R., this making his sixth consecutive term of office.

Mr. G. W. Cushing has been appointed General Master Mechanic of the Cincinnati Southern Ry., with headquarters at Paducah, Ky.

Mr. Addison Day, at one time General Superintendent of the Rome, Watertown & Ogdensburg R. R., died at Rome, N. Y., Dec. 25.

Mr. T. M. Bates will resign his position as Superintendent of the Indiana, Illinois & Iowa R. R., and will be succeeded by Mr. Lewis H. Miller.

Sir Samuel White Baker, famous for his achievements as an African explorer from 1861 to 1873, died at his home in Devonshire, England, Dec. 30.

Mr. W. H. Blood, General Superintendent of the Long Island R. R., is said to have resigned his position, and Mr. I. D. Barton is mentioned as his successor.

Mr. Arthur Sewall, who has been President of the Maine Central R. R. since 1884, has resigned his position. He has been a director of the company for 18 years.

Mr. Nathaniel Wheeler, President and General Manager of the Wheeler & Wilson Sewing Machine Co., of Bridgeport, Conn., died in that city Dec. 31 at the age of 73.

Mr. W. G. Walter has been appointed Traffic Superintendent of the Mexican Railway, which is a newly created position. He will continue as one of the representatives of the London board in his position of General Auditor.

Mr. Arthur B. Underhill has resigned his position as Superintendent of Motive Power of the Boston & Albany R. R., on account of ill health. He has held the position since Sept. 1, 1880.

Mr. W. E. Knox has been appointed Superintendent of the Alabama Mineral Division of the Louisville & Nashville R. R., with headquarters at Anniston, Ala., vice Mr. T. K. Scott, resigned.

Dr. Charles M. Cresson, of Philadelphia, Pa., the distinguished chemist, died last week. He had been connected with the Philadelphia gas works and had conducted many investigations in matters of hygiene and public health.

Mr. Chauncey H. Andrews died at Youngstown, O., on Dec. 25 at the age of 77 years. He was a prominent figure in the development of the coal mining interests in the Mahoning Valley, and the construction of railway lines in that region.

Mr. Worthington C. Smith, for many years prominently connected with railways in the Vermont Central system, died at St. Albans, Vt., Jan. 2. He was a brother of the late J. Gregory Smith, for many years the President of the Vermont Central system.

The late Geo. H. Babcock, whose death was announced in our issue of Dec. 21, left by his will a bequest of $40,000 to establish a scientific department in the public library of Plainfield, N. J. His total bequests to religious and charitable organizations amount to $240,000.

Mr. F. C. Beardsley, C. E., has been engaged by the Turkey Knob Coal Co. as engineer in charge of the development of the extensive coal lands which they have leased. Mr. Beardsley was formerly assistant and locating engineer on the Chesapeake & Ohio R. R. His headquarters will be at Mount Hope, Fayette Co., W. Va.

Mr. Wm. Richardson, for many years the President of the Atlantic Ave. R. R. Co., of Brooklyn, died in that city Dec. 31. He was born in Hertfordshire, England, in 1822, and came to the United States with his father when 12 years of age. Since 1866 he has been prominently interested in the street railway lines of New York and Brooklyn, and he won a wide reputation by his fearless work in quelling the great street railway strikes in those cities in 1886 and 1889.

Mr. Paul Louis Jousselin, President of the Society of Civil Engineers, of France, died recently at the age of 63. He began his active career on the Northern Railway, and in 1857 entered the service of the Paris, Lyons & Mediterranean Railway. He was 33 years with that road, being principally connected with the operating department. He retired from service in 1892. He was largely instrumental in introducing electrical apparatus, and the apparatus known by his name for communication between station agents and signalmen has been in general use on the Paris, Lyons & Mediterranean Ry.

NEW PUBLICATIONS.

THE ART OF CASTING IN IRON.—A complete Illustrated Exposition of; comprising the Erection and Management of Cupolas, Reverberatory Furnaces, Blowers, Dams, Ladles, etc.; Mixing Cast Iron; Founding of Chilled Car-Wheels; Malleable Iron Castings; Foundry Equipments and Appliances; Gear Molding Machines; Molding Machines; Burning, Chilling, Softening; Pouring and Feeding; Foundry Materials; Advanced Molding; Measurement of Castings; Wrought Iron, Steel, etc. Also the Founding of Statues; the Art of Taking Casts; Pattern Molding; Useful Formulas and Tables. By Simpson, Bolland, Practical Molder and Manager of Foundries, author of "The Iron Founder," etc. New York: John Wiley & Sons. Large 12mo; pp. 392; over 200 illustrations; $2.50.

After so comprehensive a title little needs be said as to the purpose of this book. The author intends it to complete the work already begun in his previous publication, "The Iron Founder," to which he calls this "A Supplement." What he has to say is plainly and well said, and the directions and advice here given are certainly of the highest interest and value to the foundryman. As a rule, the illustrations are very good and clearly express the views of the author as contained in the text.

TRADE PUBLICATIONS.

THE CONNERSVILLE BLOWER CO., Connersville Ind.; pamph.; pp. 16.

This catalogue describes a new positive blower made on the principle of the common rotary pump (two pistons shaped like a figure 8 in cross-section, rotating with their axes parallel to each other). The blowers offered by this company have their pistons planed to a true cycloidal curve by a recently invented machine, which finishes the surfaces with mathematical accuracy, and enables the two pistons to rotate with very little slip and yet without touching each other. A new adjustable journal box is another important feature of the machine.

SOCIETY PROCEEDINGS.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the meeting on Dec. 14, Mr. G. D. Hicks, Division Superintendent of the Nashville, Chattanooga & St. Louis Ry., presented a paper on the "Hobb's Island Transfer."

SCRANTON ENGINEERS' CLUB.—A preliminary meeting for the organization of a society, to be known as the Scranton Engineers' Club, was held Dec. 21, 1893, at the Coal Exchange, Scranton, Pa. A good number were present, and committees on by-laws, membership and rooms were appointed, and a meeting for permanent organization fixed for Jan. 11, 1894. The membership is intended to include all branches of the profession, and the object of the society will be the reading and discussing of papers on engineering topics. C. C. Conkling, Tem. Secy.

NEW ENGLAND WATER-WORKS ASSOCIATION.—The regular quarterly meeting will be held at Young's Hotel, Boston, on Wednesday, Jan. 10. Lunch will be served at 1 p. m. and at 2 p. m. there will be a general discussion on "The Construction of Reservoir Embankments," to be opened by Mr. L. A. Taylor, M. Am. Soc. C. E. This discussion will be followed by brief experience papers on other topics, to be contributed by Messrs. George A. Kimball, N. B. Bickford, W. F. Codd, John C. Chase, M. Am. Soc. C. E., and others.

NEBRASKA STATE IRRIGATION CONVENTION.—At the recent convention at North Platte it was agreed to urge Congress to appropriate $250,000 for an irrigation survey of the land between the 97th degree of west longitude and the eastern foothills of the Rocky Mts., the work to be done under the direction of the secretary of the interior. The convention favored the creation of the office of state irrigation engineer and the establishment of agricultural experimental stations in the study of crops, with and without irrigation. Some successfully irrigated small farms were described and the storage of storm water in the highlands was spoken of with approval.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—At the meeting on Dec. 20 the subject for discussion was the "Sewerage System of the City of Roanoke." Mr. Wm. Dunlap, city engineer, opened the subject with a paper giving a historical sketch of the city and of the various plans proposed for the disposal of its sewage and drainage by Mr. R. Hering in 1883 and 1891, by himself in the latter year, and by Messrs. Gray & Hering in 1892. He followed with an account of the work actually accomplished to present date, embracing 59,900 lin. ft. of drain from 8 ins. to 32 ins. diameter, at a total cost of $60,762, closing with a brief discussion of the various formulas and tables in use for determining the size of drains and of the system of ventilation to be adopted. The subject was adjourned to a future meeting. At the meeting on Jan. 17 the subject of "Railway Signalling" will be opened by C. S. Churchill; or, as alternative, there will be discussion on Mr. Dunlap's paper.

L. J. Carmalt, Secy.

SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.—At the meeting held on Dec. 14 Mr. Alf. O. Garde read a paper on "Silver and the Modern Methods of Extracting It from the Ore." The author described first the amalgamation process, and then Mr. P. Boss' improved continuous system, involving the use of a special grinding pan. After describing a dry crushing and roasting silver mill and the conversion of metallic silver into chloride of silver, the author proceeded with the chemical leaching process. He explained how the chloride of silver was converted into sulphide of silver by means of sodium or calcium hyposulphite solutions. The process was invented by Von Patera and Kiss, and was improved by Mr. E. H. Russell by using "extra" solution. On account of the thorough knowledge required as to the character of the ore and the chemistry of its treatment, this method of leaching silver ores has not come so extensively into use in the United States as in Mexico and Europe. Nevertheless, the author thought the lixiviation process had a great future before it, being quicker, cheaper and less injurious to health than amalgamation. Howard Berge, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 6. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Jan. 6. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Erics n.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 8. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Jan. 8. Secy., M. F. Schinke, City Hall.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Jan. 9 Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILROAD CLUB.
Jan. 9. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Jan. 9. Secy., D. W. McMorris, Burke Block, Seattle, Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
Jan 9. Secy., F. E. King, Jacobson Block.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 11. Secy., Hunter McDonald, Nashville, Tenn.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Jan. 10. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Jan. 10. Secy., F. M. Curtis, P. O. Box 1576, Boston.
ENGINEERS' AND ARCH'TS CLUB OF LOUISVILLE.
Jan. 11. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSO'N.
Jan. 12. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 13 Secy., G. O. Foss, Helena.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 16. Secy., F. W. Hart, Washington, D. C.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Jan. 16. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Jan. 16. Secy., Clement F. Street, Rookery, Chicago.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Jan. 17 Secy., L. J. Carmalt, Roanoke, Va.
ENGINEERS' CLUB OF ST. LOUIS.
Jan. 17. Secy., Arthur Thacher, Odd Fellows' Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan 17, 18. Annual meeting. Secy., F. Collingwood, 127 East 23d St., New York.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 18. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF CINCINNATI.
Jan. 18. J. F. Wilson, 24 W. 4th St.
NEW YORK RAILROAD CLUB.
Jan. 18. Annual meeting. Secy., John A. Hill, Temple Court.
SCANDINAVIAN ENGINEERING SOC. OF CHICAGO.
Jan. 18. Secy., Allen Strale, 100 Washington St.
SOUTHERN & SOUTHWESTERN RAILWAY CLUB.
Jan. 18. Secy., S. A. Charpiot, Macon, Ga.
TACOMA SOC. OF ENGINEERS AND ARCHITECTS.
Jan. 19. 201 Washington Building.
CENTRAL RAILWAY CLUB.
Jan. 24. Secy., S. W. Spear, Buffalo, N. Y.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Jan. 24. Secy., S. E. Tinkham, 36 Bromfield St.
ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 1. Secy., E. Nexsen, 501 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Feb. 2 Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 2. Secy., O. Von Geldern, 719 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 5. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHOENIXVILLE.
Feb. 6. Secy., W. Halliburton.
WESTERN SOCIETY OF ENGINEERS.
Feb. 7. Secy., Jno. W. Weston, 51 Lakeside Bldg., Chicago.

ENGINEERING NEWS

AND

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The date when the subscription expires is on the address label on each paper; the change of this to a subsequent date is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The somewhat lengthy table in this issue, giving the detail of our new navy, has been prepared in answer to numerous queries, and to meet a want felt in our own office. The new ships figure constantly in press accounts of trial trips and naval service, and owing to the lack of accessible data many mistakes are made in dimensions, steam power and battery. The table here given has been carefully prepared from material furnished by the Bureau of Construction of the U. S. Navy Department, and is correct. In some points the official trials that have taken place since the original table was made have changed the speed and power records, as in the case of the "Columbia." The records should therefore be taken as indicating contract requirements except in the case of those ships actually in service for some time and with a fixed official record.

The city of Toronto appears to be particularly successful in securing public service at low rates. The city is supplied with a network of electric car lines, operated by a private company under contract with the city. The company pays the city a rental of $800 per mile of track per annum, and a percentage of the gross receipts varying from 8% to 20%, according to the total amount received. A complete system of transfers is in force, and while the single fare is 5 cts., packages of six tickets are sold for 25 cts.; school children have half fares and workmen's tickets are sold at 8 for 25 cts. As everybody knows, custom has made the 5-ct. fare for street railways wellnigh universal in America, but it stands to reason that either this is too low a rate to give a fair return to the lines operated in small cities of a few thousand inhabitants or else it is an unwarrantably high tax on the patrons of the roads in the great cities.

In a similar way the price for electric lighting in a very large proportion of American cities is set at 1 ct. per lamp-hour, the lamp being of 16 c. p. This price is probably lower than some of the electric lighting companies in small towns can really afford. It is equally probable that this price leaves large profits to companies operating in large cities. Toronto again comes to the front with a reduction of 40% from this long established price. A year ago the Toronto Incandescent Electric Light Co. reduced its price for lights to 0.8 ct. per lamp-hour; and it has been rewarded by an increase of nearly 100% in its business during the year. This is now to be followed by a further reduction to 0.6 ct. per lamp-hour. At this rate electricity is as cheap as gas at $1.20 per M. ft., whereas at the ordinary rate of 1 ct. per lamp-hour it is as cheap as gas at $2 per thousand. This comparison is based on the supposition that the gas will give a light of 16 c. p. in a burner consuming 5 cu. ft. per hour. That even the lowest rate named above (0.6 ct. per lamp-hour) ought to leave an ample margin for profits to the company in a city the size of Toronto, is apparent when it is remembered that in a reasonably efficient plant an indicated horse power should furnish current for some 12 lamps, giving a gross revenue to the lighting company of $0.6 \times 12 = 7.2$ cts. per hour per horse power capacity of the station. If we assume the average daily output in current to be equivalent to that produced by the operation of the station at full capacity for five hours, we have the annual revenue per horse power as $\$.072 \times 5 \times 365 = \$131.40$. The fuel consumption to produce this amount of electric energy in a well designed central station of fair size would hardly exceed 3 lbs. per HP.-hour as a maximum, which would amount to less than 3 tons per horse power per annum. This would make an annual fuel bill of only $6 per horse power if $2 per ton is assumed as the average price of coal. Allowing $200 per HP. for the cost of plant, and 1-6 for interest and depreciation, we have only $33 for the fixed charges on the plant. The margin remaining of nearly $100 per horse power ought to be ample to cover all the other expenses of operation and leave a handsome income on the capital invested.

A half dozen years ago, when western Kansas was being gridironed with railway lines, the Dodge City, Montezuma & Trinidad Ry. was projected to extend from Dodge City to Trinidad, Colo., a distance of some 200 miles. It is of interest at this time to note that the population of these several municipalities in the last census year was as follows: Dodge City, 1,763; Montezuma, 354; Trinidad, 5,523. The road was completed in 1888 from Dodge City to Montezuma, 26.4 miles, at a total cost, according to "Poor's Manual," of $276,579, or $10,484 per mile. Train service has been furnished by the Chicago, Rock Island & Pacific at $18.20 per round trip. During the year ending June 30, 1892, the statistics of operation were as follows:

Train mileage, 8,199 (equivalent to one train run from Dodge City to Montezuma one day and back the next).

Passengers carried, 520; carried one mile, 12,046.

Freight carried, 3,425 tons; total ton-miles, 89,907.

Freight rates, 2.88 cts. per ton-mile; passenger rates, 3 cts. per mile.

Earnings: Pass., $362; freight, $2,590; mail, $598; total, $3,549.

Expenses: Maintenance of way and structures, $2,296 (per mile = $85); conducting transportation, $4,047; general expenses, $1,357; total, $7,700.

The road is owned by Wilson Soule, of Rochester, N. Y., and during the years since it has been in operation has accumulated a deficit of $27,409. Mr. Soule appears to have come to the conclusion that his railway was too expensive a luxury, and some three months ago he discontinued the train service. As about one-half the total cost of building the road was spent for the purchase of the rails, he next attempted to realize something on this portion of his property by selling the ties and rails to a railroad contracting firm in Chicago. When the purchaser went to take up the track he was met by an injunction secured by the inhabitants along the line of the road. The matter was argued in court and it was contended on behalf of the owner of the road that as the road was built without any local aid and had no bonded debt, he could do what he pleased with his own. The court held, however, that the public had certain inalienable rights in the road and it must not be destroyed. The owner of the road therefore finds himself the possessor of a white elephant which he can neither sell nor give away. His safest course appears to be to burn up his stock and run away before he is compelled to resume the operation of the line. There may be a moral in the above for the projectors of that North and South railway from North Dakota to the Gulf of Mexico; if so we leave it to them to find it.

Every engineer knows that, theoretically speaking, only one-fifth as much power is required to pump a given quantity of water against a 50-ft. head as against a 250-ft. head; but curiously little use is made of this knowledge in the design of water-works systems. The tendency in American water supply systems is toward the use of very high pressures, due, perhaps, to the general desire in all save the largest cities to rely on the hydrant pressure alone for fire protection. Yet it is an admitted fact that very high pressure is rather a nuisance than a benefit, as respects the ordinary consumption of water, for it is the cause of frequent breaks, it necessitates the use of heavier piping, or of reducing valves, and it multiplies greatly the loss by leakage from defective mains and fixtures. The householder had as soon have water delivered at 50 lbs. pressure, or even at 30 lbs., as at 100 lbs. This being the case, it is somewhat surprising that the attempt is not more frequently made to economize in the pumping expenses of water-works' systems by adopting low pressure, or by separating the distribution systems according to their elevation, supplying the factories, mills, etc., which in most cities are the largest consumers of water and which are generally located in the lowest portion of the city, from a separate low-pressure system, which can be given high pressure in case of fire.

We illustrate in another column of this issue a device intended to facilitate the use of a normal low pressure on a system of water supply pipes, giving at the same time high pressure from the pumps in case of fire.

Heretofore when pumps have been cut off from stand-pipes or reservoirs in order to put a heavier pressure on the mains, the cutting-off has generally been done by hand, by closing a gate valve.* The objections to this are that in closing a large gate in a force main under the hurry and excitement attended on a fire alarm, one is apt to shut the gate so suddenly as to cause a water hammer in the pipe and burst the main, the pumps being generally running at full speed when the gate is closed. In the second place, in case the gate is shut and a breakdown of the pumps should occur, the pressure at once falls to zero until the gate can be opened; and should that stick, the water supply is at an end. Again, it is desirable that the supply stored in the reservoir should immediately supplement the pumps in case the demands of many hose streams at a large fire should exceed the capacity of the pumps.

The advantage of the device which we illustrate is that the stand-pipe or reservoir is automatically shut off from the mains when filled, but at any instant when the pressure in the mains falls below that in the reservoir, a simple check valve will open and supplement the supply from the pumps.

With this device in use, the desirable form of stand-pipe for a city located on level ground would appear to be a low tank of large diameter, instead of the tall, slender structures which have been so commonly erected in the prairie cities. Such a structure could apparently be made to store a greater amount of water at less expense and with less danger of failure than a tall stand-pipe, and the economy in the pumping expenses due to the low pressure should be very considerable.

Another year has passed, and there is still no increase in the car-dispatching capacity of the Brooklyn Bridge. The promises which have been made to more than double the car capacity by what has now stood for some eight years as the "adopted" plan (the so-called Barnes-Martin plan with various modifications of detail) have not been

*A gate closing device operated by electricity, in use on the stand-pipe of the Janesville, Wis., water-works, was described and illustrated in Engineering News of Sept. 28, 1889.

fulfilled as yet in any degree, for no overt attempt has been made as yet to put that plan into actual use, and no increase whatsoever in car-dispatching capacity has been made since the subject began to be agitated in 1885-6. In accordance with what has become our annual custom (for this is now the sixth year in which we have done so) we simply note this fact at the beginning of each succeeding year, awaiting the proof of experience whether or not the views which have been expressed in these columns as to the possibilities under that plan, or any other of its kind, are correct. That view, as careful readers of this journal will remember, is that it is a physical impossibility to increase by 100 or any other material percentage the number of cars dispatched per hour under that plan or any other, other than the one recommended by the trustees' first Board of Experts, but not accepted by them. Pending the actual trial of that or some other plan it is of course idle to discuss the theoretical issue further; but considering that the ostensible ground for giving preference to the present adopted plan was its certainty, safety, cheapness and ease of construction, it must be admitted that there has been no great haste in putting the plan to the test, and that the trend of events, so far, rather tends to confirm our position. What has been done so far in all these years is merely to expend some $1,000,000 for real estate at the Brooklyn end, to extend the bridge toward the City Hall, and for approaches and plazas, to purchase some ground and put in the foundations for some lateral extensions of the station at the New York end, and to make four or five new plans in relation to details, some of which are still pending. The trains are still dispatched in the good old way, and the car dispatching capacity is still what it has been for eight years, and neither more nor less. In the meantime the traffic of the bridge as measured in number of passengers still increases slowly by virtue of more and more crowding, but even this increase has almost ceased, because there is a limit even to the number of persons who can crowd into a car.

NATURAL FILTRATION OF WATER.

For some time past the people of Pittsburg and Allegheny, Pa., have been concerned regarding the quality of their water supplies. The death rate from typhoid fever in both these cities is high and has been for years. Allegheny has a truly alarming typhoid mortality, which seems to be on the increase. Both cities have recently been talking of filtering their water, and Allegheny is now considering the expenditure of $300,000 for this purpose.

At the meeting of the Engineers' Society of Western Pennsylvania held Oct. 17, 1893, Mr. Gustave Kaufman, M. Am. Soc. C. E., of Pittsburg, read a paper entitled "Natural Filtration of Public Water Supplies," in which he pointed out the freedom of well selected ground water from disease germs and advocated the construction of filter galleries beneath the bed of the Allegheny River.

Mr. Kaufman's plan is substantially as follows:*

The Allegheny River has the immense watershed of over 10,000 square miles above Pittsburg. Underneath its bed is a gravel deposit from 40 to 50 ft. in depth. A large number of wells in the neighborhood of Pittsburg have been sunk along its shores, and they have uniformly yielded large amounts of water. These facts, together with the experiences of other places similarly located, are sufficient, in the writer's opinion, to warrant the assertion that sufficient quantity could be obtained for the supply of Pittsburg and Allegheny from the bed of the river. The wells sunk along the shore have produced hard water, unfit for boiler purposes, but it may be that the ground water under the center of the stream is soft, which can readily be determined by test holes.

In view of its freedom from pathogenic bacteria and the comparative low cost of softening, the hardness of the local ground water should not be an obstacle to its use. As ground water in a city is liable to contamination from the seepage of sewage, all works for collecting it should be located above the city limits.

For galleries depending largely upon a supply from the river, the writer suggests a series of flumes at least 15 ft. wide and 4 ft. high, made of wood and sunk into trenches dredged transversely in the bed of the stream. These should be placed as far apart as possible and should lead into a collecting gallery placed parallel to the stream. As a precaution against silting, a stand-pipe should be constructed whose contents could be emptied at will into any one of the infiltration galleries. In order to reduce the probability of tapping the ground water and to avoid the necessity of softening, the flumes could be placed in one of the numerous riffles of the Allegheny at a depth of about 10 ft. below low water.

With the coarse gravel found in the bed of the Allegheny, a rate of infiltration of 300 gallons per sq. ft. per day can be safely assumed, so that for a supply of 30,000,000 gallons per day 100,000 sq. ft. of area would be required. This can be obtained with seven galleries, 15 ft. wide and 900 ft. long.

*Mr. Kaufman's paper was published in the October proceedings of the above named society.

Before considering this plan a word should be said about the amount of water required by these two cities. The daily per capita water consumption in both Pittsburg and Allegheny is abnormally high, having been about 150 gallons at Pittsburg and 240 at Allegheny in 1890 (see "Consumption of Water and Use of Meters," Eng. News, Jan. 16, 1892, or the introduction to the "Manual of American Water-Works" for 1890-91). The combined water consumption of the two cities in 1890, not including the large area in Pittsburg, supplied by the Monongahela Water Co., was 61,000,000 gallons, or double the amount allowed by Mr. Kaufman, after a lapse of three years. Unquestionably this consumption could be greatly reduced by the use of meters, but after years of wastefulness it would require some time to get below 100 gallons per capita, by which time the population would have increased to a large extent. Therefore an average daily supply of at least 40,000,000 gallons would be required for the two cities at the start, if it be assumed that meters were to be used; otherwise a supply of from 60,000,000 to 80,000,000 would be required.

During the discussion which followed the reading of the paper, it was urged that natural filtration, as installed years ago at Lawrence and Lowell, Mass., Providence, R. I., and later at other places in this country, had proved unsatisfactory. This has undoubtedly been the case at many localities, principally through a gradual decrease in the yield of the filter galleries, and to a less extent on account of deterioration in the quality of the infiltered water. But both decrease in yield and deterioration in quality are accounted for by the fact that the sand and gravel surrounding the gallery becomes clogged with the suspended matter deposited by the infiltrating water. Mr. Kaufman proposes to wash out this matter by a reversed flow of water under stand-pipe pressure. Just how successful such washing would be seems uncertain, for the plan has never been tried on a large scale. (See Eng. News, April 11, 1891, for a description of a similar method of washing a small filter gallery at Eureka, Cal.)

Judging from past experiences it does not seem probable that many engineers could be found who would approve such a plan for a great water supply when the results which may be expected from either mechanical filters or artificial filter beds of sand are so much better known and, on the whole, have so much greater promise.

Natural filtration unquestionably yields most admirable results under proper conditions, that is, when the water has passed slowly through a long stretch of sand and gravel, but with filter galleries in the bed of the river only 10 ft. below low water, probably most of the water secured would have passed rapidly from the river to the galleries, so that instead of natural there would result only artificial filtration. If the galleries were placed deeper, or if some form of tube wells were sunk, naturally filtered water might be secured, but Mr. Kaufman states that such water might prove hard. If hard water should be inevitable he states that a softening process at an annual cost of some $2,000 per year for each 1,000,000 gallons daily supply might be used. This, however, would mean an annual operating charge of $60,000 to $80,000, or more, according to the consumption, an expense which the people of these two cities might well bear if pure water could not be secured without, but which it seems likely can be avoided, even if Mr. Kaufman's plan for filter galleries should be adopted.

ROAD LEGISLATION IN THE UNITED STATES.

The investigation into road construction and management in the United States by the U. S. Agricultural Department and under Gen. Roy Stone as special agent, is said to be making good progress. State geologists are beginning to supply information as to materials available for road construction, and 50 engineers of railway companies have sent in reports. This material is now being tabulated and a map is in preparation which is to show the location and cost of the best available roadmaking material throughout the country. A bulletin is soon to be issued outlining the new road laws of 14 states.

General Stone will say that road legislation is proceeding on ten distinct lines, ranging from more rigid operation of the old system to the direct building of state roads. Tennessee gives the county courts full power and direct control over roads and eliminates local politics and prevailing easy-going methods. The courts classify the roads, establish districts, appoint commissioners and assess road taxes. Vermont, New Hampshire, North Dakota and Oregon increase tax levies for roads; the latter state allows county courts to levy a special tax of 50 cts. on the $100 and $2 per head for a county road fund. New Jersey absolutely abolishes the payment of road taxes in labor and the abolition is almost absolute in Wisconsin. In Oregon, Indiana, and by special acts in Ohio, local assessment applies to construction for a three-mile limit on each side of the road. In Oregon the county may assume half the cost, and in Ohio a large share is assessed upon the county. In Pennsylvania and New Jersey much work has been done by townships and by township bonds. The issue of county bonds is provided for in New York, New Jersey, Indiana, Michigan and Washington; but in the two latter states a popular vote is required to authorize the issue.

State highway commissions have been created in Massachusetts, Vermont, Pennsylvania, Ohio, Michigan and several other states. Massachusetts has the only permanent body of this character charged with important duties connected with actual road construction; the other commissions can only inquire into existing conditions and recommend methods for improvement. New York is experimenting with convict labor on roads near the Clinton prison, and Tennessee law makes available for this purpose all prisoners confined in county jails, or workhouses.

New Jersey is probably the only state giving direct aid to roadbuilding, the report says. This aid is limited to one-third of the roads built by the counties and to the sum of $75,000 per annum. The highway commission, of Pennsylvania, has reported a bill for state aid to the amount of $1,000,000 per annum to be distributed among townships in proportion to the road tax paid by them. The townships, according to this bill, must set aside 25% of their tax for making permanent highways. Co-operative roadbuilding, as provided for in New Jersey, has been very successful. Abutting landowners pay one-tenth of the cost, the state one-third, the county the remainder by sale of bonds. Under this law, ten miles of road were built in 1892, 25 in 1893 and 64 are applied for by landowners for 1894.

The data already gathered shows that new roads are constructing in many parts of the country and that increased knowledge and skill, improved machinery and methods and extended practical experience are rapidly lessening the cost of good roads. Civil Engineer Harrison, of Asbury Park, N. J., is authority for the statement that while three or four years ago the cost of roadbuilding was $10,000 per mile, it was last year $3,500 a mile. Prof. J. B. Hunnicutt, of the University of Georgia, in response to an inquiry from the bureau, states that the cost of good hard roads recently built in Georgia, providing for a track of stone and one of earth, was $1,200 a mile. Supervisor Chapin, of Canandaigua, N. Y., in a letter to General Stone, reports that ten miles of a single-track stone road, with an earth track each side, was built in that town for $700 a mile. Active interest in the movement for better roads is shown by the railroads generally. Special or reduced rates are offered

by many railroads and a tabulated statement of the various concessions in shipment rates by a large number of companies has been prepared.

LETTERS TO THE EDITOR.

THE CARLIN HUNTING PARTY—PERSONAL.

Sir: The Carlin hunting party, of which I was a member, has been sadly misrepresented and unjustly censured by the whole press of the country. Many of the criticisms are personal attacks upon Mr. Carlin, the head of the party, and myself, and are based in many cases upon conditions purely imaginative and speculative. Some of these criticisms reflect upon me professionally and require correction.

It is useless, of course, to go into details and attempt to describe the situation within the scope of a brief communication. Persons who have never been in the wildest regions of the far Northwest, or similar places in South America or elsewhere, can form no idea whatever of that vast and almost impenetrable "sea of mountains" from a pen picture; nor can any one who has never undertaken a "hard trip" into such mountainous districts comprehend the real difficulties that are invariably encountered. For these reasons it is a difficult matter for the uninitiated to imagine any circumstance whatever which would justify the actions of the Carlin party.

The engineering corps that worked through the canyon of the Clearwater River in the summer of 1882 are the only persons known to have passed down the river over the same route we did; and they alone can furnish reliable information concerning the rough character of that region, and the special dangers which would menace a party traveling through it as late as the latter part of November, when the rainy season had set in.

As to our actions toward George Colgate, our cook, I assert that when the details are made known, and the whole situation is thoroughly understood (as it will be when the pamphlet or book now in preparation is published), our actions will be proved to be not only justifiable, but honorable and praiseworthy.

I would also state that the party was at no time "lost." Our delay in getting out of the mountains at the appointed time was due to the fact that we could not return by trail with the sick cook. The only other route over which we could hope to get him back to civilization was the river. The building of the rafts and other preparations for this trip, together with the journey down the river, consumed nearly five weeks, whereas the journey to our camp over the trail was accomplished in eight days.

In this connection, let me add that all the maps of the vast region extending from central Idaho eastward to the Bitter Root Mountains that I have thus far examined, including the map issued by the U. S. government, of the Department of the Columbia, are extremely inaccurate and unreliable.

A. L. A. Himmelwright, Civil Engineer.

New York, Dec. 26, 1893.

A CONUNDRUM IN TRANSIT WORK.

Sir: Will you kindly inform me who is right on the following: A claims that the rail lines of a tangent on level grade are light curves and cannot, theoretically, be separately run by transit, as the center line is run, without making deflections, as in running in ordinary curves. B says A is wrong.

Yours respectfully, A Subscriber.

San Luis Obispo, Cal., Dec. 15, 1893.

(A is correct, although the matter at the bottom of this conundrum is one that only becomes of practical importance in geodetic work and in extended land surveys. Briefly explained, the plumb line on a perfect transit when set up points to the center of the earth and the plane in which the transit revolves is a plane passing through the center of the earth and forming a great circle by its intersection with its surface. Now, another transit set 4 ft. 8½ ins. (or any other distance) from the first and sighted in a line exactly parallel with the first will also have its plumb line pointing to the center of the earth, and the plane in which this second transit revolves will intersect the plane in which the first transit revolves in a line running from the center of the earth to its surface at a point distant 90° from the point where the transits are set up. Hence the line produced by a transit being the intersection of the plane in which it revolves with the earth's surface, it is evident that any two transit lines produced by pointing the instruments in directions exactly parallel will actually converge until they finally meet at a point on the earth's surface 90° distant.—Ed.)

PHOTOGRAPHY AND MINING REPORTS.

Sir: The art of underground photography has of late made such progress as to deserve the special attention of mining engineers. By its aid they may now illustrate their reports with pictures plainly showing the exact appearance of ledges, ore bodies and other features of importance; and if the practice of employing such illustrations once becomes general, the value of mining reports will be considerably enhanced. Indeed, I doubt not that in the near future no mining report will be considered satisfactory if it be not fully illustrated by means of photography.

As an example of the excellent results now obtainable, I send you a copy of a report I have just made upon the Mayflower and South Mayflower mines, on the great "Mother Lode," in Amador Co., Cal. This report, as you will observe, is illustrated by some exceptionally fine photographs of points underground; and I trust you will permit me to add that in the event of any of your readers being desirous of having a copy I shall be very happy to supply the same free of any charge, as I think that by so doing I shall be aiding mining engineers in general.

Your obedient servant,

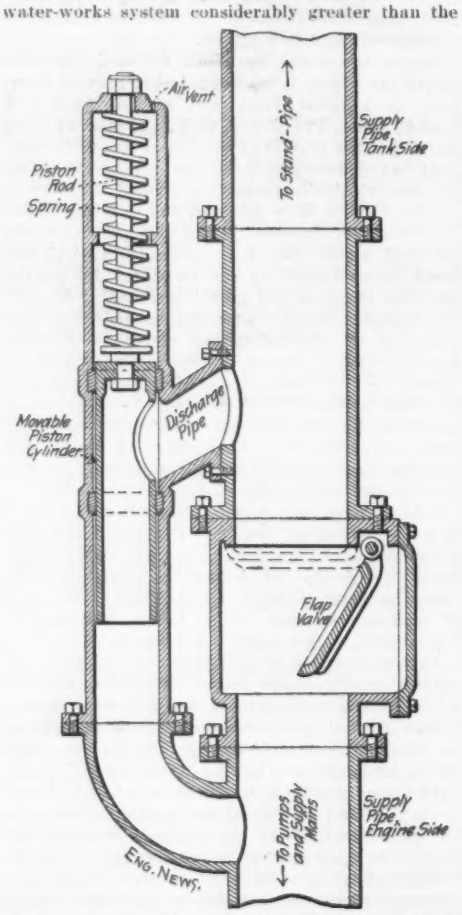
Stephen H. Emmens, M. Am. Inst. C. E.

San Francisco, Dec. 15, 1893.

(We agree with our correspondent, that half-tone reproductions from photographs might be used much more extensively in illustrating engineers' reports. Unfortunately, a large amount of such work that has been done has been robbed of its effect by the use of inferior half-tones. A good photograph may be made into a muddy and indistinct half-tone by a poor workman, and engineers should insist on having good cuts from good photographs.—Ed.)

AN AUTOMATIC EXCESS PRESSURE RETAINING VALVE FOR WATER-WORKS.

The accompanying illustration shows a device which enables a fire pressure to be created in a water-works system considerably greater than the



An Excess-Pressure Retaining Valve for Water-Works.

stand-pipe pressure, but without the difficulties and dangers which have heretofore beset this plan of operation. One of these valves is to be used in connection with the stand-pipe of the water-works for the village of South Milwaukee, Wis. It was designed by Mr. J. H. Dousman, of Dousman & Sheldon, Milwaukee, Wis., who has applied for a patent on the device.

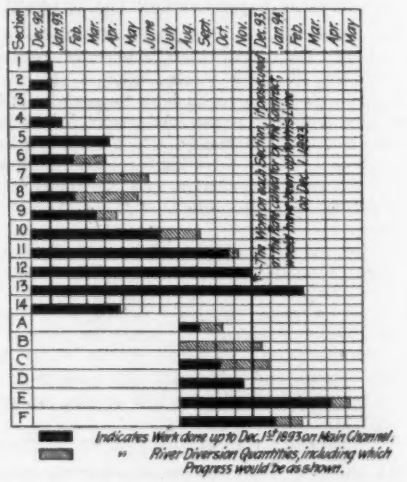
The operation of the device may be explained as follows: When the pump is idle the water flows from the stand-pipe to the mains through the straight pipe connection, thus giving the full pressure due to the head in the stand-pipe.

When the pump starts up and begins to send a surplus of water to the stand-pipe, the check valve closes, but the water still enters the stand-pipe through the by-pass. If now a fire pressure is desired, the pump is speeded up. The spring which holds down the piston valve in the vertical by-pass pipe is set under an initial compression sufficient to just balance the pressure due to the head in the stand-pipe when it is nearly full. When the pressure passes this point, the piston is raised and the port leading to the stand-pipe is closed, thus preventing further water passing to the stand-pipe. Any pressure which the pumps can keep up can then be put upon the mains. In case a breakdown of the pumps should occurr, however, or the demands on the mains should be greater than the pumps can supply and maintain the pressure, the check valve at once opens and the water in the stand-pipe flows into the mains. The packing of the piston may be changed to suit liquids other than water, if desired, and, of course, the spring may be adjusted to any desired pressure. By having a flange joint just above the lugs midway in the length of the spring, the piston and accessories could be removed very readily.

We have commented on the advantages arising from the use of the device in our editorial column. The only difficulty that we can perceive in its use is the danger of water hammer occurring when the piston valve closes the port to the stand-pipe. This could be guarded against very simply by shortening the piston valve a little, so that a water hammer in excess of the safe limit would raise the piston so far as to again uncover the port leading to the stand-pipe.

PROGRESS ON THE CHICAGO DRAINAGE CANAL.

The Board of Trustees of the Sanitary District of Chicago is after its delinquent contractors with a sharp stick. At the meeting of the board on


Section
Dec. '92
Jan. '93
Feb.
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Apr.
May
June
July
Aug.
Sept.
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Nov.
Dec. '93
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Feb.
Mar.
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The Work on Sec. 1 Partial, Work on Sec. 2 Completed, Work on Sec. 3 Partial, Work on Sec. 4 Completed, Work on Sec. 5 Partial, Work on Sec. 6 Completed, Work on Sec. 7 Partial, Work on Sec. 8 Completed, Work on Sec. 9 Partial, Work on Sec. 10 Completed, Work on Sec. 11 Partial, Work on Sec. 12 Completed, Work on Sec. 13 Partial, Work on Sec. 14 Completed, Work on Sec. A Partial, Work on Sec. B Completed, Work on Sec. C Partial, Work on Sec. D Completed, Work on Sec. E Partial, Work on Sec. F Completed, Dec. 1, 1893.
Indicates Work done up to Dec. 1st 1893 on Main Channel.
" River Diversion Quantities, including which Progress would be as shown.

Progress of Work on Chicago Drainage Canal by Sections to Dec. 1, 1893.

Section.	Contractor.	Section.	Contractor.
F.	Ricker, Lee & Co.	5.	Agnew & Co.
E.	Streeter & Kenefick.	6.	Agnew & Co.
D.	E. D. Smith & Co.	7.	Agnew & Co.
C.	Western Dredging & Improvement Co.	8.	Agnew & Co.
		9.	Agnew & Co.
B.	Heldmaier & Neu.	10.	E. D. Smith & Co.
A.	Heldmaier & Neu.	11.	Mason, Hoge & Co.
1.	Alfred Harley.	12.	Mason, Hoge & Co.
2.	McArthur Bros.	13.	Mason, Hoge & Co.
3.	Gilman & Co.	14.	McCormick Construction Co.
4.	McArthur Bros.		

Dec. 20, Mr. Thos. T. Johnston, Acting Chief Engineer, submitted a report by Superintendent of Construction J. W. Weston, giving a detailed account of the progress of work on each section of the canal up to Dec. 1, 1893. The accompanying diagram, reproduced from this report, shows that on the sections for which contracts were let in the fall of 1892, the only contractors who are well up with their work are Mason, Hoge & Co. The record of total work on all sections shows that less

than half the amount was completed on Dec. 1 that should have been done according to the terms of the contracts. The actual figures are: Amount required to be done Dec. 1, 1893, by contracts, $3,420,446. Amount actually completed, $1,621,673.

On Dec. 28 the trustees voted to order the forfeiture of the contracts on Sections 5, 6, 7, 8 and 9, held by Agnew & Co., and that on Section 1, held by Alfred Harley, and after the necessary notice has been given the contracts will be readvertised. With reference to Section 1, Superintendent Weston reported that only $25,878 worth of work had been done, whereas $171,481 should have been completed on Dec. 1. Work on the section was suspended last May and there was no ground for expecting any improvement in the rate of working under the present contractor.

Sections 2, 3 and 4 are those in which the controversy occurred with McArthur Bros., and which were finally relet in October. The superintendent states that work is being pushed since its resumption the middle of November at a rate largely in excess of contract requirements, and present appearances indicate that these sections will be completed on time.

Sections 5, 6, 7, 8 and 9 are not only far behind, as shown by the diagram, but are being operated under sub-contracts, which is in violation of the contract with the Drainage Board. A large proportion of the work done on these sections has consisted in skimming off the top soil with scrapers, teams and wheelbarrows, and dumping it close to the bank of the canal so that all the material excavated from the lower strata of the canal will have to be hauled over or around these first great spoil banks. In other words, to economize in length of haul the contractor is placing obstacles in the way of the successful prosecution of later work.

The contractor on Section 10 is somewhat increasing his rate of progress and has now an extensive plant in operation, including three cantilever conveyors, four steam hoists with 38 cars and an air compressor plant, from which are operated 8 channelers and 13 drills. It is of interest to note that the number of cubic yards moved per day since July 1 has averaged 308 for each channeler and 178 for each steam hoist.

Section 14 is that for which the McCormick Construction Co. held the contract. This contract has just been sold by order of the court.

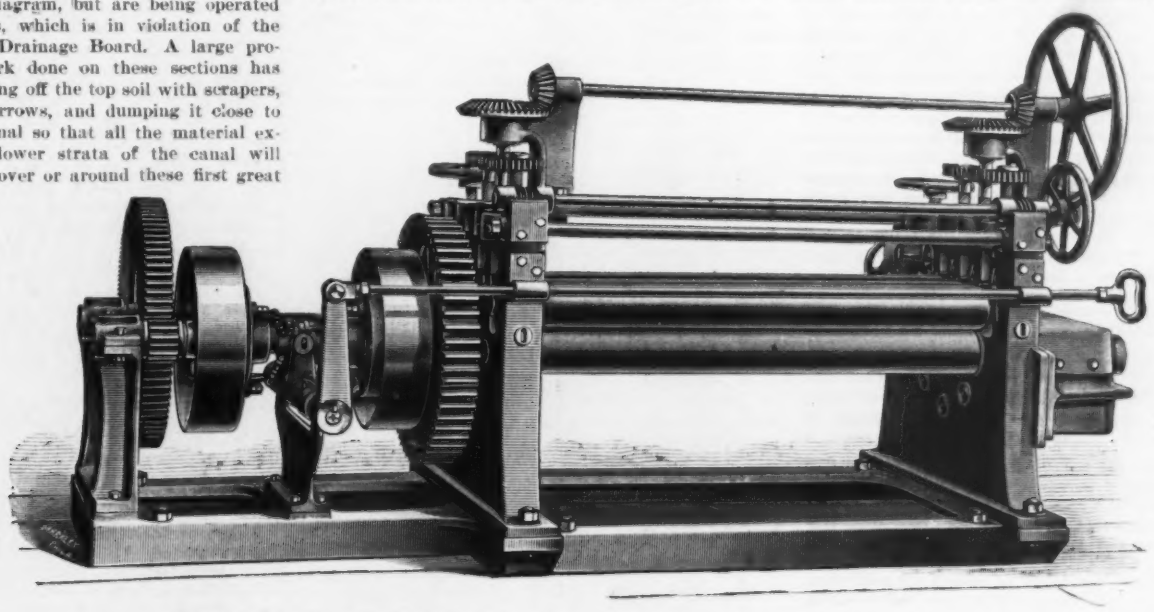
Work on Sections A, B, C, D, E and F, began on April 1, 1893, and as seen from the diagram, has on the whole made good progress. The deficiency on some of these sections is stated to be due to the encountering of unforeseen difficulties rather than to any lack of energy on the part of the contractors.

The diversion of the Des Plaines River has been practically completed during the past year. This work aggregates about 13.3 miles of newly constructed river channel, 200 ft. wide, and requiring the excavation of about 1,600,000 cu. yds. of glacial drift, and 240,000 cu. yds. of solid rock. All along this new channel for a distance of 20 miles (with the exception of part of Section A) a levee averaging 12 ft. in height has been built. This river diversion, as already noted in these columns, will prevent in great measure the flushing out of the Chicago River into the lake by the floodwaters of the Des Plaines.

PLATE STRAIGHTENING MACHINE WITH EIGHT ROLLS.

We illustrate in the accompanying cut a general view of the plate straightening machine now being built by the Hilles & Jones Co., of Wilmington, Del., especially for use in shipyards and locomotive shops and bridge works. The machine illustrated is intended for straightening iron or steel plates from No. 12 to ¼ in., but machines of the same design are constructed for working almost any width or thickness desired.

The number of rolls in this tool is eight, four above and four below. Three of the upper rolls are set alternately with three of the lower rolls and the fourth upper and lower rolls are directly opposite each other in the vertical plane. The peculiarity of the tool consists in this arrangement of the rolls, which is patented, and which is claimed to be more effective for flattening plates than the ordinary seven-roll machine, as a positive pinch or compression is exerted by the opposite rolls, which, taken in connection with the corrugating tendency of the other rolls, is a great aid in taking out the "buckles" in the plate. The machine is driven by duplex friction clutch pulleys which avoid the shifting of the belts. All pinions conveying power to the bottom rolls are made of steel. The large hand wheel raises and lowers three of the upper rolls at the same time, the smaller hand wheel being used for vertical adjustment of the outside top roll. The fourth top or pinching roll is entirely independent of these.



IMPROVED PLATE STRAIGHTENING MACHINE. Hillis & Jones Co., Wilmington, Del.

IRONBARK AND JARRAH TIMBERS.

There has lately been some interest displayed in this country in regard to the use of the ironbark and jarrah timbers of Australia, which are of great value in many engineering works on account of their exceptional durability. We are indebted to Mr. B. E. Fernow, Chief of the U. S. Forestry Division, for the following letter and appended particulars as to the value and durability of these timbers:

Replying to your inquiry regarding the jarrah wood **I would first say that it is not the same as Australian ironbark, but both ironbark and jarrah are species of the numerous family (nearly 300 species) of** eucalyptus; namely, Eucalyptus leucoxylon, the ironbark, and eucalyptus marginata, the jarrah or mahogany tree of southwest Australia. Both of them are celebrated for their indestructibility by fungi or climatic influence. Both of them are, therefore, used for railway ties, but the latter especially. I cannot do better than to send you a copy of the account given by the eminent botanist of Melbourne, Baron von Mueller, regarding the durability of jarrah wood. In regard to the price, I have not been able to find any quotations, even in the "English Timber Trades Journal," and do not know anything regarding its importation into the United States. The only note regarding price I can find is on the ironbark in Australia itself, namely, 2s. 5d. (say, 60 cts.) per cu. ft. at Melbourne. There are said to exist forests of jarrah to the extent of 9,000,000 acres, yielding at the average of 500 cu. ft. per acre. It should be understood that the quality changes with the conditions of growth just as with timbers in our own country, which is very often overlooked. It seems to me that with the quality claimed for these timbers it might well compete with our best oak for railway purposes in the Eastern markets.

Some particulars of these timbers have been given in our issues of Oct. 26, Nov. 30 and Dec. 7, and further particulars of the use of jarrah for paving will be found in our issues of Sept. 8, 1892, and June 22, 1893, while in our issue of Oct. 31, 1891, were given some details of the hardwood ties used in Australia. The following is the extract sent us by Mr. Fernow:

In referring to the almost unrivaled superiority of the jarrah timber as well nigh indestructible and yet easily worked, we may quote here the high authority of a professional judge, Mr. H. E. Victor, C. E., Swan River, who, after a long local experience, reported on this wood substantially as follows for the Paris Exhibition of 1878: "Open to air and weather, on wind and water line, under the soil or submerged, it is not materially affected, remaining intact after nearly 50 years' trial. The choicest timber is obtained from the summit of the granite and ironstone ranges. Trees grown on sandy plains near the sea yield a timber of inferior quality, twisted, also shorter in the grain and much less durable. The forests are of considerable extent, covering an area of approximately 14,000 square miles, full of noble trees, springing from among rocky boulders to a height, clear of branches, of from 50 to 60 ft., straight as a mast, and attaining a maximum girth of 20 ft. The committee of Lloyds, on Governor Sir F. Weld's representation, informed Earl Kimberley that this timber ranks with those named in the line No. 3, Table A, attached to the rules for the classification of ships. According to this estimate it was for shipbuilding second only to English oak and to American live oak, standing before sal (shoren robusta) and teak (tectona grandis), the two highest class timbers of India, and also before the celebrated greenheart (nectandra rodiaei) of Guiana."

The Imperial Government Clerk of Public Works of West Australia, speaking from more than 20 years' experience and use of considerable quantities of this timber, states: "It is remarkably free from the action of nearly all the ordinary forms of decay incidental to woods in contact with or buried underground, under water, at mortises and joints, in piles in sea jetties and in planking of seagoing vessels. Without sheathing or other protection, it has proved sound and enduring to an extent which appears to denote exemption from decay, so far as evidence can be derived from observation of timber exposed for upward of 30

years. I have recently taken up piles, which were driven for a whaling jetty in the year 1834 or 1835; the timber is small but perfectly free from boring machine mollusca, although the place is swarming with the teredo. In the old jetty work at the port of Fremantle, piles which had been driven for 30 years and others only about one year, could scarcely be distinguished, both being equally sound; large iron bolts through them have entirely corroded away, leaving the holes clean and sound. Round piles, with only their bark peeled off, driven before seasoning, appear to stand as well as those which were squared and seasoned. Young as well as matured wood had effectually resisted the attack of boring sea worms and crustacea. A cargo boat, upward of 20 years old, exposed all the time and as often high and dry as afloat, is as sound as when it was launched. Coasting craft, which had been more than 10 years afloat without copper sheathing, are prefectly seaworthy, not a plank perforated nor a butt end rotten. A sampling rope, which had been set up to mark a shoal near Fremantle, sheathed with copper and guyed with iron chains, was found on inspection to be uninjured after 20 years' exposure. A chip of it was taken from the waterline with a pocket knife and looked like cedar, but the copper sheathing and iron chains had both perished. Land boundary posts, put in 40 years since, show neither weathering, nor rot nor injury from termites; letters cut on them are still clean and sharp. This is the case also with slabs in the cemetery at Perth, bearing inscriptions dating as far back as 1834. Flooring of cottages, wet and dry, according to the season, laid on the ground without joists, after 25 years, show no signs of decay on either side. As jarrah has been the timber used throughout the colony of Western Australia since its foundation in 1829, there are numerous examples to refer to, proving its durability. Properly cut and properly dried, the material would prove in practice as durable as iron, and, under some circumstances, would outlive it. The time occupied in drying ought to be one month for every inch in thickness, if timber is sawn or hewn; but if round it requires only to be banded at the ends to prevent splitting."

FORESTRY IN THE UNITED STATES.

The report of the Executive Committee of the American Forestry Association shows that the work of the association is beginning to bear fruit, as may be seen from the following abstract of reports recently issued by the association:

Not only has the policy of reserving public timber lands for forestry purposes, established by the last administration, been recognized by the present administration, in reserving some 4,500,000 acres more (the Cascade Range and Ashland Timber Reserves in Oregon), making the total acreage in forest reservations nearly 18,000,000, but there is ground for hope that some rational legislation for protecting and utilizing these reserves may be enacted. Members of the association and all friends of forestry are requested to urge upon their representatives the passage of House bill No. 119 as a first step toward a more rational use of the public timber lands.

While the action of the President and the assurances of the passage of such legislation are encouraging as committing the government to a sound forestry policy, we have grounds for encouragement in other directions. The devotion to forestry of a special building and the creation of a special department of forestry at the Columbian Exposition are signs that our subject is permanently established, and the action of the Exposition authorities has done much to widen the circle of those who appreciate our endeavors. The special meeting of the association at Chicago under the auspices of the World's Auxiliary Congress has been helpful in the same manner, and was successful especially in impressing the representatives of the lumber trade with the legitimate aims of the association and the need of its work for the benefit of the lumber interests.

The president of the association is at the head of the U. S. Department of Agriculture; one of our former secretaries is in charge of the public timber lands at the General Land Office; and the Chairman of the Public Lands Committee in the House of Representatives is fully persuaded of the necessity of new legislation along the lines urged by the association; and there is a realization that virgin forest resources have shrunk so as to expose as childish the cry of "inexhaustible" supplies, and the knowledge is at last dawning on the irrigators of the West that "the forest waters the farm," while there is a general awakening of public interest in the forestry movement, which purposes to turn the irrational destruction of a great national resource into a rational husbandry of the same.

The provisions of the bill mentioned above are extremely simple. Protection of the forest reservations (now comprising nearly 18,000,000 acres) is sought by the employment of the army, which has done such effective work in both the Yellowstone Park and Yosemite reservations. The Secretary of the Interior is empowered to make such rules and regulations and establish such service as will insure the objects of such reservations, namely, to regulate their occupancy, to utilize the timber of commercial value and to preserve the forest cover from destruction. He is also empowered to have cut and to sell timber on non-reserved lands under the same regulations as made for the forest reservations, provided that it shall be first shown that such cutting will not be injurious to the public interests. The proceeds are to form a special fund to be expended in the care and management of such reservations, i. e., making them self-supporting. This bill was in part drafted and is indorsed by officers of the American Forestry Association, and is hereby recommended for support and propaganda by all friends of the association.

DIAGRAM FOR FLOW OF WATER IN 6-IN. TO 84-IN. PIPES.

The accompanying diagram for determining the discharge, slope and velocity of 6 to 84-in. pipes flowing full was plotted by Mr. A. S. Tuttle, Jun. Am. Soc. C. E., of Brooklyn, N. Y., from Kutter's formula, using $n = 0.013$. The velocities range from 2 to 6 cu. ft. per second, and the slopes from 1 ft. in 200 to 1 in 3,600, while the discharges range from 0.2 to 220 cu. ft. per second. It is

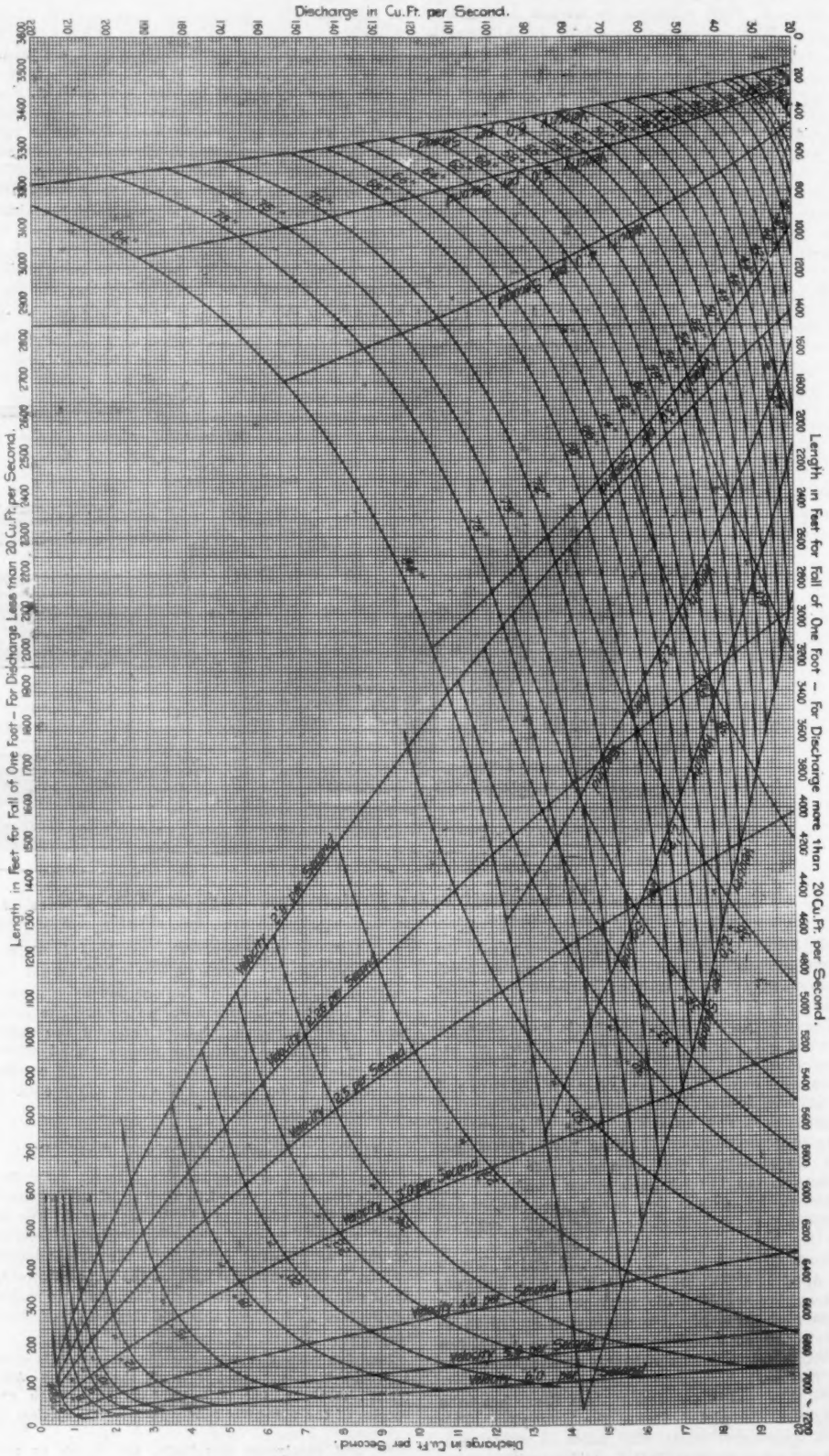

Discharge in Cu.Ft. per Second.
Length in Feet for Fall of One Foot – For Discharge Less than 20 Cu.Ft. per Second.
Length in Feet for Fall of One Foot – For Discharge more than 20 Cu.Ft. per Second.
Velocity 2 feet per Second.
Velocity 3 feet per Second.
Velocity 4 feet per Second.
Velocity 5 feet per Second.
Velocity 6 feet per Second.
Slope 1 in 200.
Slope 1 in 300.
Slope 1 in 400.
Slope 1 in 600.
Slope 1 in 800.
Slope 1 in 1000.
Slope 1 in 1200.
Slope 1 in 1400.
Slope 1 in 1600.
Slope 1 in 1800.
Slope 1 in 2000.
Slope 1 in 2200.
Slope 1 in 2400.
Slope 1 in 2600.
Slope 1 in 2800.
Slope 1 in 3000.
Slope 1 in 3200.
Slope 1 in 3400.
Slope 1 in 3600.

DIAGRAM FOR FLOW OF WATER IN 6-IN. TO 84-IN. PIPES

(Based on Flynn's Modification of Kutter's Formula, with a = 0.013.)

stated that the diagram is applicable to the following materials: Ashlar and well laid brickwork; ordinary metal; earthenware and stoneware pipe in good condition but not new; cement and terra cotta pipe not well jointed and not in perfect order; plaster; planed wood and glazed surfaces of every sort when in imperfect or inferior condition.

For hydraulic diagrams published in previous volumes of Engineering News see list in issue of April 27, 1893.

Since the above was put in type Mr. Tuttle informs us that the diagram is based on the late Mr. P. J. Flynn's modification of Kutter's formula, in which s (fall of water surface in any distance divided by that distance), in the very complex value for the term c (or coefficient of mean velocity), is taken as a constant of 1 to 1,000. This modification gives practically the same results as Kutter's formula for all slopes sharper than 1 to 5,000 and even beyond that limit for large pipes. For instance, the accompanying diagram and Kutter's formula show the following results for 60 and 84-in. pipe with the slopes as given:

Size of pipe, ins.	Slope.	Diagram. Velocity, ft. per sec.	Diagram. Discharge, cu. ft. per sec.	Kutter's formula. Velocity, ft. per sec.	Kutter's formula. Discharge, cu. ft. per sec.
60	1 to 4,400	2.03	40.0	2.001	39.3
84	1 to 7,120	2.0	77.0	1.962	75.591
84	1 to 1,150	5.0	192.2	4.986	1.9

THE AIR-BRAKE SITUATION.

The recent decisions in the air-brake patent cases, sustaining the validity of the patents on the quick-action triple valve which are held by the Westinghouse Air-Brake Co., make the future policy of that company a matter of great importance to the railways of the country.

Briefly summed up, the situation is this: It is now generally accepted that the quick-action air-brake is to be in the near future a necessary part of the equipment of every freight car. This is true, first, because of the advantages in safety, efficiency and economy which arise from its use, and secondly, because Congress, to secure the greater safety of trainmen, has enacted a law making the use of air-brakes compulsory in moving all freight trains carrying interstate traffic after Jan. 1, 1898, four years hence.

There are now probably not far from 350,000 freight cars in service equipped with air-brakes, and estimating the total number of freight cars in the United States at 1,200,000, there are about 850,000 cars to be equipped during the next four years. According to the recent patent decisions the railways can purchase this equipment only of the Westinghouse company and were that company disposed to take unfair advantage of the complete monopoly which has been placed in its hands, the railways would certainly be placed in a hard position.

These circumstances make the announcement of its future policy, made by the Westinghouse company, in a pamphlet just issued, of great interest and importance. After reciting the history of the development and introduction of the quick-action freight brake through the genius and untiring perseverance of George Westinghouse, the results of the recent litigation with the New York Air Brake Co. are summed up and the announcement of future policy is then made as follows:

The rights of the Westinghouse Air-Brake Co., as thus defined in both opinions of the court, would appear to give us control of the quick-action air-brake business. Infringement suits have been begun against the other companies which offer to sell quick-action air-brakes.

Thus far we have endeavored to explain what our legal rights are, and upon what they are based; but our position in relation to the railways is stronger than this. It should not be forgotten that the railway interests of this country are indebted to the Westinghouse Air-Brake Co. alone for all the security afforded by air-brakes. This company has, alone and unaided, brought the efficiency of the air-brake up to its present standard. It is true that the Master Car Builders' Association, by their tests, pointed out the defects of former brake systems; but neither this Association nor any competitor suggested any method or apparatus which has elevated the art. The railway world is none the more secure, and it has not, in any way, been benefited, at any time, through competition in the air-brake business.

It has always been our policy to spare no expense essential to secure the highest quality of material and workmanship in the apparatus which we furnish, and, although holding a commanding position, to furnish it at reasonable prices. The Westinghouse Air-Brake Co. has never, at any time, increased its prices, although its apparatus has been constantly undergoing improvement and the manufacture of it has become more costly.

The perfecting of the quick-action air-brake was accomplished only by the expenditure of about $200,000, and it is considerably more expensive to manufacture than the older forms; but its introduction was not accompanied by any increased price. While we shall protect our rights at all hazards, our patrons may confidently expect a continuance of our established policy of supplying brake apparatus of the highest efficiency at fair prices.

It has been customary in the past for the railways to refer to us cases of annoyance or difficulty arising from the use of the air-brake. We have, at large expense to us, aided our patrons in the adjustment of such difficulties. No one can, therefore, understand so well as we do the necessity of absolute interchangeability of like parts and of uniform and simultaneous operation of all the air-brake apparatus in a train. We are confident, therefore, that, in protecting our rights and maintaining a uniform system of air-brakes, we are also serving the best interests of all the railways of this country, and we shall, in the future, as we have in the past, neglect no opportunity to give the railways the greatest security which can be derived from the use of power brakes.

During the competition which prevailed in the brake business while the New York company was in the field, many railway officers expressed themselves in favor of fostering such competition. Their reasons for this were doubtless the fear of an extortionate policy on the part of the Westinghouse company in case their patents were sustained by the courts.

If, however, the railways are assured that the Westinghouse company intends to take no more than a fair and reasonable profit on its products, we take it that every railway man familiar with air-brake practice will be glad to see the business remain solely in the hands of the Westinghouse company. The perfect uniformity of action, which is so essential in air-brake construction, cannot be so well secured if several different shops are turning out brakes as if one great establishment has the production in its own hands. It is agreed by all that every air-brake equipment in freight service must be interchangeable with every other. In other words, the whole freight brake equipment of the country is part of one vast machine of which any number of pieces must work together, as soon as connected, with absolute reliability. It stands to reason that such a machine of the complicated character of the air-brake, should be made to one standard.

With the assurance of fair prices and honorable treatment which is given in the quotation above, and which has been repeated to us by representatives of the Westinghouse company, the railways are to be congratulated on the upholding by the court of the Westinghouse patents.

LIFE OF CAST IRON WATER PIPE AT ST. JOHN, N. B.

Some interesting information regarding failures in cast iron pipe which has a bearing upon its life is given by Mr. Gilbert Murdoch, M. Am. Soc. C. E., Engineer and Superintendent of the waterworks of St. John, N. B., in his report for 1892. The information is based on observations of pipe breakages which occurred during the year.

A 4-in. main, which had been in use about 33 years, failed in marsh mud under a pressure of 60 to 65 lbs. per sq. in. The outside of the pipe had undergone a softening process at the break, which was along some air cells in the body of the shell. The film of metal covering the cells and sand holes was about ⅛ in. thick and could be cut easily with an ordinary knife. Below the film and the air cells the metal seemed to be as clear and sound as when first laid. The internal diameter of the pipe was reduced by about ½ in. of tuberculation.

Air cells also caused the failure of a 2-in. pipe, laid in brick clay. Tuberculation had reduced the diameter of this pipe to about one-half and its area to about one-fourth of its original size.

A 6-in. pipe of domestic make, 52 years old, failed from softening. It was in soft, slaty rock, and was as easily cut as plumbago, and when cut showed a bright smooth surface. A rent 8 ins. long was found in this pipe. The metal on one side of the pipe proved to be ¾ and on the other barely ¼ in. thick. The break occurred on the thin side; and along the ragged edge of one of its sides the metal was not more than 1-16 in. thick.

A 24-in. pipe, in well drained gravelly brick clay, failed on Feb. 16, 1893, after having been in use since 1857, or about 36 years. Along the line of rupture there seemed to be numerous minute air cells and a general lack of homogeneity. No large blown spaces were shown, but there were indications of "cold shut" at several points. One side of the pipe was found to be 1¼ and the other barely ¾ in. in thickness. The rend was irregular, about 7 ft. long and on the thin side of the pipe. The outside of the pipe was sound, but on the inner side a coating less than 1-16 in. thick, which looked like black vegetable matter, showed and remained after the tubercles were removed. Below this coating the iron was bright and fresh. The pipe had not been subject to water-hammer and had never given previous trouble. It was made in Glasgow, Scotland, in 1856, and was unprotected inside or out.

Barring accidents and inherent defects in manufacture, Mr. Murdoch states that so far as an opinion can be formed from experience with this pipe, its duration is practically indefinite. This conclusion, it must be remembeerd, relates to a pipe line of uncoated cast iron.

The tuberculous growths on the section of 24-in. pipe were pretty well distributed around its interior, the largest number being on the under side, when there was any difference. The largest tubercles had a base of about 1¼ in. and a height of about ⅝ in. This and previous observations lead to the conclusion that from ⅝ to ¾ in. is the maximum height of the growth, or a reduction in the effective diameter of the pipe amounting to 1¼ to 1½ ins.

Most of the joints on the above line of pipe were made with small pine staves cut to the curvature of the pipe. The wood taken out at the time of the accident was fresh and sound and some of it was preserved as a curiosity.

The break was shown on the pressure gage in the city at 7:30 a. m., the trouble was located by 9 a. m., and, although the ground was frozen for 3 ft. in depth, by 10 p. m. the old pipe was cut out, a new piece inserted and the pipe line ready for refilling.

THE PARTIAL PURIFICATION OF SEWAGE.

By Geo. E. Waring, Jr., M. Inst. C. E.

While the final problem of the purification of sewage relates to such a complete withdrawal or destruction of its organic elements as will leave its water pure enough for safe drinking, or at least for discharge into a stream from which drinking water is to be taken, still it often happens that what is really needed is only to remove so much of its suspended and coarser contents as will make it clear, and will enable us to discharge it into water that is not to serve for domestic purposes, without infringing the rights of owners who use the stream for power, for manufacturing uses, for watering cattle or for pleasure.

It is well understood that complete purification can be attained in no other practical way than by application to land, either by broad irrigation or by well regulated filtration through sand or gravel, or other porous material, which may be readily permeated by air, application being in either case intermittent, in order that the field or the filter may have a chance for such aeration. For this complete result none of the processes of chemical precipitation will suffice. For partial purification they are effective, and they are often resorted to, in spite of their cost and their cumbersome character, where suitable land cannot be procured without too great outlay.

The chemical processes have their limitations, which cannot, apparently, be passed, and their maintenance involves an outlay for chemicals, power and labor which is serious. The investigations of the Massachusetts Board of Health, carried on during 1889 by Mr. Allen Hazen, and submitted, with a summary of results, by Mr. Hiram F. Mills, the engineer member of the board, were conducted with scientific accuracy ,and the conclusions drawn from them may be confidently ac- ..

cepted. Mr. Hazen's comments end with this statement:

> It is possible to remove from one-half to two-thirds of the organic matter of sewage by precipitation with a proper amount of an iron or aluminum salt, and it seems probable that, in some cases ,at least, if the process is carried out with the same care as is required in the purification of sewage by intermittent filtration, a result may be obtained which will effectually prevent a public nuisance.

Mr. Mills fixes the annual cost of chemicals alone at about 30 cts. for each head of the population, and he gives, as an average result, the removal of from 51 to 58% of the albuminoid ammonia. As to bacteria, he says that of 700,000 (in a "thimbleful"), 35,000 remained in the effluent, and continues:

> If any of these are disease-producing germs, there would be no safety in turning such a liquid into a drinking-water stream; and whether it would be admissible to turn a liquid containing from one-third to one-half as much nitrogenous organic matter as sewage, with abundant bacteria, into any other stream, would depend upon nearly the same conditions that would attend discharging a less amount of sewage into the same stream. There would, however, be this difference, and it is an important one, the objectionable appearance would have been removed, and would not come again, unless, collecting in pools or in eddies or on flats, or rising to the surface on a liquid having greater specific gravity, putrefaction of the remaining organic matter should follow. . . . . But the incompleteness of the purification and the cost of 30 cts. per inhabitant yearly for chemicals, together with the additional expense of manipulation and disposing of the sludge, will be likely to confine the application of chemical precipitation in the purification of sewage to narrow limits.

The natural conclusion from these experiments and from general experience in practice is that, while the results of chemical processes are always incomplete, they are availbale for use where partial purification will suffice, and may be advisable under certain conditions.

In discussing the subject it is almost universal to consider the use of irrigation only with a view to complete purification, and to set it aside wherever something less than completeness is really demanded, if the large area needed for complete work and the cost per acre would call for so great an outlay as to indicate an economy in the use of a chemical method. It seems to have been overlooked that irrigation may be carried on to a point of partial purification only, and that this, while producing at least as good a result, would reduce the cost below that of the chemical method.

In sewage irrigation, if the flow is first passed over a coarse screen, its rags and rubbish will be withheld, leaving only minor solids to reach the field. As it flows on over the surface the fibrous matters and the gummy portions are soon deposited, leaving the flow with the appearance of a thin liquid, discolored like laundry waste. As the sheet of sewage passes on over the land, its discoloration decreases, and a point is soon reached where so much of it as still remains above ground has the appearance of clear water, is without odor, and is at least as pure as ordinary brook water. What has sunk into the ground will, of course, be as thoroughly purified as if the rest had continued to flow until all was absorbed, and this portion will appear as a pure effluent in the drainage. When this point has been reached, purification has been carried far enough for the demands of the situation, and it is not necessary to spend money to provide for more than this.

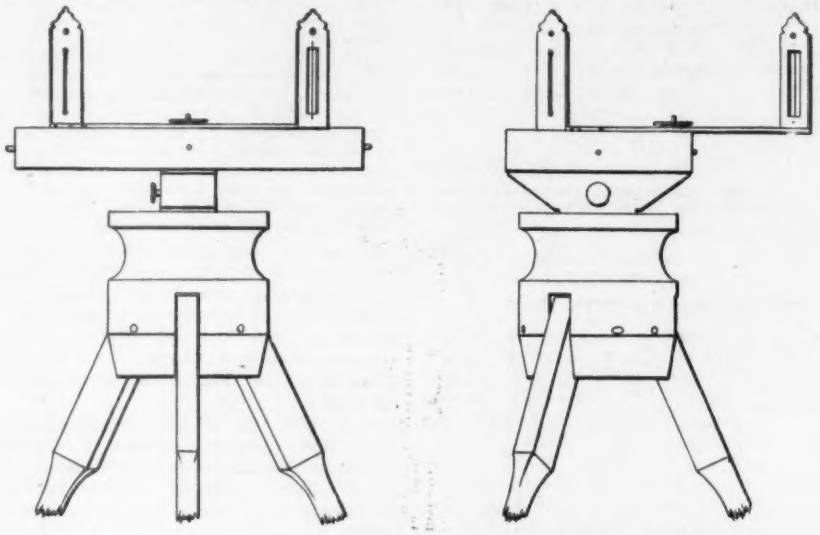
Naturally there must be several different areas for alternate use in the fullest extension of the system. In fact, as far as we go, we are using precisely the same methods that would be used for absolute purification. The only difference is that we stop when the flow is pure enough for our purposes; and that we haye saved the cost of land purchase and maintenance for the later stages of purification which we do not need.

A good illustration is given of the effect of a limited flow at the irrigation field at Wayne, Pa. (See Eng. News, Nov. 3, 1892.—Ed.) This field is a hillside, so steep that it is necessary to arrest the sewage at short intervals, to keep it from forming rills, giving it a fresh start for further distribution. It is so arrested behind horizontal barriers and its improving condition is observable at each. There are three separate sections for alternate use, one day of flooding being followed by two days of rest and aeration. Each of these three sections above the third barrier is about 1.28 acres in extent. The spaces between the barriers on the different sections vary a little, but not materially. Each has at its upper side a small tract of broken stone, to catch coarser matters, but the liquid sewage flows from this substantially unchanged. On the first section the area, including this stone bed and to the first barrier, is about 16,750 sq. ft. Between the first barrier and the second, it is about 11,000 sq. ft.; and between the second and third, about 28,000 sq. ft. The combined area to this point is about 55,750 sq. ft., or, to the same point in the three sections, about 167,250 sq. ft., or 3.84 acres.

The soil is a micaceous loam, with many small boulders, and is rather sparsely covered with forest trees. This portion of the field is not underdrained artificially, but the surface is absorptive enough to take in more than one-half of the flow before the lower limit of the area under consideration is reached. The volume of sewage amounts to about 200,000 gallons per day. The reservoir from which it is pumped holds about eight hours' flow. The pumps discharge at the rate of about 10,000 gallons per hour. This amount flows for about 20 hours over one of the sections described above. Less than one-half of this amount, measured by the eye, reaches the barrier at the lower edge; as it flows on it all sinks into the ground long before reaching the lower limit of the whole section.

This description relates to the conditions as they existed during the first year of the working. Two additional sections are now used for night work, and the pumps are run only during the day, the reservoir being emptied early in the evening, and enough of the night flow running into it to fill it again by morning. During the time when all of the sewage went to the first three sections, their conditions and their results improved steadily, and they are still improving. The sewage arrested behind the barrier in question looks clear and is entirely odorless. It is freely drunk by dogs. Were it to flow in that condition into the brook, it would not change its natural cleanly appearance. Then, too, it is to be remembered that an equal volume has been absorbed by the land and is completely purified, so that the whole, taken together, is twice as pure as that which we see. If the inclination of the land were less steep, more would be absorbed, and the purification would be still better.

Now let us see how this figures out, as applied to a certain population. The whole area used (for the partial purification) is 3.84 acres, including about 19,000 sq. ft. covered by broken stone, so that each acre receives on an average about 51,000 gallons of sewage per day. If we take the usual allowance of 60 gallons per head, we have the sewage of a population of 850 sufficiently purified by an acre of land, under conditions as to soil and inclination less favorable than are usually found. There is no sludge to be handled, there are no chamicals to be bought, there are no filter presses to be run and there are no tanks to be cleaned. The whole attention required is usually given by one man, who has time for much other work. The purification is better than chemical processes can secure. The condition of the resting tracts is such as to indicate that they might be used every other day without difficulty. This would raise the limit of population to 1,300 per acre.



AN EARLY SURVEYOR'S COMPASS.

There has recently been published an excellent report of the sewerage and sewage disposal of the city of Canton, O., (see Eng. News, June 1, July 20 and Sept. 14, 1893, for full description. —Ed.), where, as a measure of economy, and as partial purification would suffice, the chemical method was adopted. The land (27.58 acres) was bought for $4,000. On this a chemical plant was constructed at a cost of $26,484. The statement has been made that the cost of operating this plant is $5,000 per annum per 1,000,000 gallons of daily flow.

The amount of sewage at Canton is about 800,000 gallons per day. If the same result could be attained there as at Wayne, then a better purification would be secured with 13 acres under broad irrigation, and at a comparatively insignificant outlay for preparation and attendance. The result would probably be better, as the land is much more nearly level, and the sewage is fully one-half groundwater leakage and clean flushing water. The present population is about 14,000, not nearly half of them connected with the sewer. If the whole field were applied to sewage irrigation, the rate would be about 500 persons per acre. This would seem, therefore, to be a case where great economy and a better result would have been secured if partial purification by broad irrigation had been adopted.

AN EARLY SURVEYORS' COMPASS.

By Charles W. Sherman, Jun. Am. Soc. C. E.

In Pilgrim Hall, Plymouth, Mass., which contains many interesting relics of our Pilgrim Fathers, there is shown a curious surveyors' compass, which is probably one of the first surveying instruments used in this country. The card attached to it reads:

ANCIENT COMPASS,
Which Belonged to One of the Early Wadsworths, of Duxbury. Presented by Stephen Holmes, of Kingston.

A family tradition, which, unfortunately, cannot be verified, says that this instrument belonged

to Christopher Wadsworth, who lived in Duxbury before that town was set off from Plymouth. We actually find his name upon the records as early as 1633.

The instrument bears no maker's name or date and is not at all like the surveyor's compass of to-day, as will be seen from the accompanying illustrations. In fact, it looks much like an exceedingly small plane-table, its principal parts being a "table" and an alidade. The compass proper is shaped like the one often used for orienting a plane-table, and, except that it forms part of the table, is used in the same way. The table is of hard wood about $4\frac{1}{2} \times 8\frac{1}{4}$ ins. in size. A little to one side of the center there is a rectangular recess in the wood, and in this the needle is mounted. The inside of this "compass box" is painted white, and there are marks at the ends to which the ends of the needle are to be brought, thus "orienting the table."

At one side of the table a compass sight alidade is mounted on a fixed center, about which it may be turned in the direction of the line to be surveyed. A semi-circle is graduated to degrees upon the surface of the table, with its center at the pivot of the alidade. Half the width of the alidade is cut away at each end just inside the sight, and the edge beveled. The bearing is read on the arc opposite this beveled edge. One end of the alidade always overhangs the table unless the line runs very nearly north and south. The alidade is made of one piece of brass, bent up at the ends to form the sights. One sight is slotted, while the other has a rather coarse brass wire stretched across it. There are no levels on the compass.

The tripod head looks like the top of an old bedpost, into which three slim legs are fastened by wooden pins. The legs are not more than $\frac{5}{8}$ in. in diameter, and are about 3 ft. 5 ins. long. They are unshod. The needle is round, and is brought to a point at the ends, instead of being flat, with the end brought to an edge, as in our modern instruments. There is no way of lifting it from its pivot, which must be considerably blunted by this time, yet it still seems rather delicate. The glass cover of the compass box is held in place by putty.

The instrument folds up for packing in very convenient shape. The "table" may be lifted from the peg in the tripod head, about which it revolves, and after unscrewing the thumb nut the alidade may be removed from its pivot and placed about three edges of the table, where it fits exactly and is held in place by three small brass pegs which pass through holes in the alidade, the spring of the brass being sufficient to keep it on the pegs. No steel or iron is used in the instrument, except, of course, in the needle. There seems to be no reason why this instrument might not be used to-day, with results nearly as good as ever.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

BOSTON & MAINE.—There now remains but three narrow bridges between Boston and North Winchester to be widened before the proposed four-track line can be completed between the two places.

BOSTON & NOVA SCOTIA.—About 300 men were employed last week clearing the right of way for this railway between Orangedale and Broad Cove mines, Cape Breton, 35 miles. The construction is expected to be commenced in earnest as soon as weather permits in the spring. Ch. Engr., C. M. Odell, Mabou, Cape Breton.

DELAWARE & HUDSON CANAL CO.—The Ausable branch of this railway is being extended by the J. J. Rogers Co., Ausable Forks, N. Y., from Rogers through Ausable Forks to its new pulp mill beyond. When completed the extension will be 4.23 miles in length and will become a part of the D. & H. C. Co.'s system. The grading has been completed from Rogers to Ausable Forks, 2.75 miles, and in the spring the remainder of the line will be graded and the track laid. Engrs., Chappell & Burke, Rutland, Vt.

GEORGES VALLEY.—It is reported probable that this railway will be extended to Appleton, Learsmont and Liberty, in Maine. Ch. Engr., Wm. Lee, Bucksport, Me.

LONG ISLAND.—It is stated that this company has made arrangements for extending its Port Jefferson branch 12 miles eastward to Wading River. There is also talk of extending the Montauk division east to Amagansett.

OTTAWA, ARNPRIOR & PARRY SOUND.—An official of this road writes us as follows concerning the work done during the past year: On Jan. 1, 1893, we had 36 miles graded and track laid. Since that we have graded to Golden Lake, a distance of 85 miles from Ottawa, having graded 49 miles this season. We have also laid track for the whole distance of 85 miles and ballasted 75 miles of this during 1893. The road was built on Dominion government specifications and no expense has been spared on it. It is ballasted with over 3,000 yds. to the mile, all permanent stone bridges, arches and culverts and steel superstructure. Eight stations have been built, all on stone foundations, and some of the buildings are of brick. The rails are 72 lbs. to the yard and are on split switches. This portion of the line was opened for traffic Dec. 18, and is managed by the officials of the Canada Atlantic Ry. All the equipment is new and of the most modern type. The tanks are of a uniform size, supplied by steam power and have a capacity of 60,000 gallons. This portion of the line just described runs due west from Ottawa toward Parry Sound. We are also doing some rock-work this winter from the 85th to the 95th mile. Besides this we have built 10 miles more this season, making 30 miles in all, on the Parry Sound Colonization Ry., which was bought a year ago by the O., A. & P. S. Ry. Co. This makes a total of 125 miles of the projected 250 miles of road. J. R. Booth, lumber merchant, Ottawa, is president, and Geo. A. Mountain, Ottawa, is chief engineer of the above mentioned lines.

PENNSYLVANIA CO.—It is positively announced at Detroit that this company has secured an entrance into that city, with terminal facilities at the Front St. union station. The present division terminus is at Toledo, and it is reported that the entrance to Detroit will be made by the Wabash double-tracking its line from Detroit to Romulus and the Flint & Pere Marquette building a new line from Monroe to Toledo, all to be completed by next July.

WESTERN MARYLAND.—C. O. Vandevanter, Prin. Asst. Engr., Baltimore, sends us the following information concerning the extension of the Baltimore & Harrisburg from Porter's Station on the main line to York, all in Pennsylvania. The total length of line is 15.07 miles, of which 3.62 miles of track were laid in 1892 and the balance of 11.45 miles between Jan. 1 and July 12, 1893. The entire line is stone ballasted, which was done between April 18 and Sept. 12, on which date (Sept. 12) the road was opened for traffic. The following are the stations, with their distances from the junction at Porter's: Menges, 3.10 m'l s; Spring Grove, 4.26; Nashville, 6.66; Thomasville, 8.66; Bott, 10.63; Richland Ave. (York), 14.42, and West York Station, 15.07.

Projects and Surveys.

BALTIMORE NORTHERN.—William Gilmor, Granville, O. Wilson, John Henry Miller and S. Johnson Poe, of Baltimore, and Moses H. Houseman, of Pennsylvania, are the incorporators of this company, noted last week. Mr. Miller is said to control the Penn Anthracite Co., and was formerly president of the Baltimore & Lehigh. Mr. Gilmor was president of the Maryland Central, and Mr. Houseman was general counsel of the companies.

CENTRAL MICHIGAN.—A press report from Battle Creek, Mich., states as follows: Charles E. Thomas, attorney for the new railway between this city and Grand Rapids, to be called the Central Michigan, has received a letter from the president, J. W. Boynton, of Grand Rapids, stating that the survey between Battle Creek and Grand Rapids was completed last week. The line will have but little grade. It will run through Bedford, Banfield, Hickoryville, Gun Lake, Bowen's Mill, Gaines Center and Paris. The citizens of this city are becoming fully aroused to the importance of the road.

CHICAGO, UNION CITY & CINCINNATI.—It is stated that the contract for building this projected railway has been awarded to McNair & Barcey, Chicago, and that the construction will be commenced within two weeks. The road will extend from Union City, Ind., through Bluffton, Montpelier and Portland to Huntington, a distance of 80 miles. Ch. Engr., I. Frank White, Union City, Ind.

OHIO.—The Cleveland "Leader" states as follows: It was reported last week, on what appears to be reliable authority, that Henry S. Ives will build a connecting line of railway between Columbus and Washington Courthouse, or Greenfield, Fayette county. This will join the Cleveland, Akron & Columbus, possession of which Mr. Ives acquired sometime ago, to the Ohio Southern, of which he has practical control. The construction of this new road would give a through line from the Jackson county coalfields to the great lakes. From Washington Courthouse, or Greenfield, another connecting line of 15 to 25 miles in length will also be built, so as to tap the Cincinnati, Portsmouth & Virginia at Hillsboro, Highland county. This would give a through line from Cleveland to Cincinnati. This rumor accounts for Mr. Ives' anxiety to secure the Cleveland, Akron & Columbus, a railway which never has been profitable and the purchase of which caused much curious speculation at the time.

ONTARIO.—It is stated that application is made to the Ontario legislature for a charter to incorporate a company to construct a railway from Port Lock Harbor, on Lake Huron or Sault Ste. Marie, northeasterly by way of the Desert Lake iron mine, to Chapleau, on the main line of the Canadian Pacific.

Southern—Existing Roads.

ATLANTIC COAST LINE.—Press reports state that Maj. W. J. Gordon, Fredericksburg, Va., is making surveys for this company for a belt line around Petersburg, Va., the road, if built, to be used for through freight trains.

ATLANTIC, SUWANEE RIVER & GULF.—It is expected that the first 20 miles of the road from Jacksonville, Fla., will be completed early next month. The line is projected from Jacksonville to Dead Man's Bay, on the Gulf of Mexico, a distance of 100 miles.

SOUTH CAROLINA.—A branch has just been completed from Ten Mile to the works of the Read Fertilizer Co. on the Cooper River, a distance of 3¾ miles, which will be used to haul freight, and may be used for passenger business as well when the works are completed. C. S. Phelps, Asst. Engr. South Carolina Ry., had the work of construction in charge.

TURKEY KNOB COAL CO.—An extensive lease of coal lands near the head of Loup Creek, Fayette City, W. Va., has been secured by this company, and a railway will be built to connect with the Loup Creek branch of the Chesapeake & Ohio. Coal tipples will be erected and coke ovens put in. Power will be furnished from an electric light plant. The construction has been begun and the plant is to be in operation by April 1, 1894. F. A. Beardsley, Engr. in Charge.

Projects and Surveys.

BELVA & ELK RIVER.—Incorporated in West Virginia to build a railway from Belva, Nichols county, to the north of Blue Creek, on Elk River, Kanawha county; capital stock, $60,000; C. H. Eaton, Charleston, W. Va.; E. A. Smith, S. N. Grammont, A. M. Williamson and F. J. Farley, Providence, R. I.; principal office, Charleston, W. Va.

Northwest—Existing Roads.

GREAT NORTHERN.—The Denver "Republican" states that the idea of a direct line of railway between that city and Duluth is not impracticable. The Denver & Gulf, extending from Denver to Julesburg, has severed its connection with the Union Pacific, and only 250 miles of railway would have to be built across Nebraska to reach O'Neil, where a connection would be made with one of Jas. J. Hill's lines for Duluth.

INDIANA & ILLINOIS SOUTHERN.—New ties and rails will be laid and other improvements made on this road in the spring, according to reports. Gen. Man., P. H. Blue, Sullivan, Ind.

TOLEDO, PEORIA & WESTERN.—Reports state that the main line of this road will be changed to run to Burlington, Ia., instead of Keokuk, as at present. In this event the branch track from La Harpe to Burlington will be rebuilt and straightened.

Projects and Surveys.

CHICAGO, PADUCAH & MEMPHIS.—Incorporated in Illinois to build a railway from Altamont, Effingham county, Ill., to Metropolis, Massac county, Ill; capital stock, $2,500,000; principal office, East St. Louis, Ill.; directors, Benj. F. Johnston, Rodey Kelly and P. M. Johnston, St. Elmo, Ill.; J. W. Griswold and J. J. McLean, East St. Louis, Ill., and Wm L. Huse and Jos. Dickson, St. Louis, Mo.

EASTERN.—Incorporated in Illinois to build a railway in Mercer county; capital stock, $50,000; principal office, Rock Island, Ill.; Henry Curtis, Robt. Lee, R. H. Hudson, H. P. Greenough and F. H. Rockwell, Rock Island.

Southwest—Existing Roads.

MISSOURI PACIFIC.—It is reported that a branch line will be built from Jefferson City, Mo., to Boonville in the spring.

TERMINAL R. R ASSN. OF ST. LOUIS.—A mortgage has been filed to secure an issue of $5,000,000 of 5% gold bonds. Jas. W. Hanna, Secy., is reported as stating that the money will be used to finish the new station and possibly build one or two terminal roads. It is very likely that a belt road will be built on each side of the river, but the time for commencing work has not been decided upon.

Projects and Surveys.

BENTONVILLE, FORT GIBSON & SOUTHWESTERN.—Incorporated in Arkansas to build a railway from Bentonville, Ark., southwest up to the Indian Territory line; capital stock, $250,000; incorporators, N. S. Henry, D. H. Woods, J. A. Rice, F. M. Bates, J. C. Knott and W. H. Cloe, Bentonville, Ark.

DAKOTA, WICHITA & GULF.—E. Stoddard, Omaha, a member of the executive committee, has been investigating the harbor facilities at Galveston with a view to making that city the southern terminus of this proposed railway. This scheme proposes a railway from South Dakota to the Gulf of Mexico, 1,350 miles, and has been referred to several times as a Farmer's Alliance project. The provisional directors will meet at Topeka, Kan., Jan. 9, to perfect organization. Fred. J. Close, Topeka, Chn. Ex. Com.

LITTLE ROCK, HOT SPRINGS & TEXAS.—The cities of Hot Springs and Little Rock, Ark., are reported as having raised the funds requested by Uriah Lott to secure the construction of this railway. The incorporation of the company was noted Dec. 14.

SAN ANTONIO & BROWNSVILLE.—The citizens of Duval and adjoining counties in Texas are reported as anxious to have a railway constructed from San Antonio to Brownsville, by way of the town of San Diego, and a mass meeting has been held at which a committee was appointed to solicit subscriptions toward the proposed enterprise. A large bonus has already been raised, which will be tendered to any responsible persons who will undertake to build the road, according to reports.

SAN ANTONIO & GULF SHORE.—Incorporated in Texas to build a railway from San Antonio to some point on the west bank of the Brazos River at or near Velasco, a distance of about 200 miles in an easterly direction from San Antonio through the counties of Bexar, Wilson, Gonzales, De Witt, Jackson, Wharton, Matagorda and Brazos; capital stock, $2,000,000; incorporators, William Davis, Robert E. Sadler, H. E. Jones, J. R. Jones, William H. Brooker, J. C. Davis and J. R. Davis, San Antonio; Wm. H. Hansom, J. Brown King, Wm. A. King, J. H. Montgomery, Virgil B. Coley and J. A. Rogers, of Gonzales county; C. R. Martin, of Grayson county, and R. W. Crowder, of McLennan county. Mr. Davis is reported as stating that arrangements are about completed with Kansas City contractors to build the first 50 miles of the road.

TEXAS.—It is reported that the citizens of Matagorda county have $75,000 in cash which they will give to the company building the first railway through the county. The county people are willing to construct the line themselves, according to reports, if the cost is not too great. Address C. H. Williams, Cedar Lake, Tex.

Rocky Mt. and Pacific—Existing Roads.

COLORADO MIDLAND.—Work on the extension of the Midland Terminal from Midland to Cripple Creek, Colo., is being pushed by Clough & Davidson, contractors, as rapidly as possible, the work this winter being mostly rockwork. Surveys are now in progress for a continuation of the line from Cripple Creek to Canon City.

FLORENCE & CRIPPLE CREEK.—The construction of this railway from Florence, Colo., on the Denver & Rio Grande, to Cripple Creek, has been commenced in earnest by Orman & Crook, contractors, Pueblo, Colo. Press reports state that $1.75 per day is paid for common laborers and $2 for teamsters, and Mr. Crook is reported as saying that 1,200 men will be kept at work from now till May, when the contract calls for the completion of the road. The Bessemer Steel Works, Pueblo, has a contract for 3,000 tons of 50-lb. steel rails. The road will be 40 miles long and have a 3-ft. gage. Ch. Engr., H. A. Sumner.

GREAT NORTHERN.—The opening of the extension from Butte, Mont., to Anaconda, 27½ miles, was inaugurated by this company last week, according to reports.——Press reports state that M. J. Carrigan, Port Angeles, Wash., has returned from the east, where he secured the necessary funds for building an extension of this road, to be known as the Everett, Port Angeles & Pacific, from Everett to Port Angeles, 67 miles. The work will require 43 miles of track, 14 miles being by ferry. The construction of the road is expected to be commenced early in the spring.

SAN DIEGO, YUMA & PHOENIX.—A press report from San Diego, Cal., states as follows: Mayor Carlsen telegraphs from the city of Mexico that he has secured a concession and a bonus for building a railway across Lower California to Yuma. This will assure construction of the proposed road from San Diego to Phoenix, Ariz.

Projects and Surveys.

COLORADO.—It is reported that the citizens of Del Norte and Saguache, in the San Luis Valley, want direct railway communication and that surveyors are staking a route for a railway along the west side of the valley, which the farmers offer to furnish ready for the rails if the Denver & Rio Grande will operate the road.

SALT LAKE CITY & LOS ANGELES.—R. L. Walker, Topeka, Kan., is reported as making the following statement concerning a projected railway from Salt Lake City to Los Angeles, Cal.: For two months I have been in New York, and our company, which owns about 4,000 acres of coal lands on the Canary and Cedar mountains in Utah, Nevada and Southern California, proposes to build the road. It has already been surveyed, and will be about 700 miles in length. Our coal beds are the nearest of all to Southern California, and our coal supply would be shipped to that territory, and could be sold there much cheaper than they are at present paying for it. The only way they get coal at present is by ship, and it costs $10.50 a ton. If our company does not build the road, some other one will, but there is no doubt, I think, about our building it.

Foreign.

MEXICAN CENTRAL.—A press report from the city of Mexico states as follows: Several important extensions are being arranged for additions to the system of the Mexican Central R. R. Officials of the road are reticent as yet regarding what the new additions will be, but promise to give out the information in a day or two. The new extensions will be feeders to the lines already in operation, and it is pretty well known that one of these will be from the city of Guadalajara westward through the rich agricultural district of the Pacific slope, while another will go into the cotton belt from Lerdo to San Pedro. A third branch will probably be built from Jimenez to Parral.

MEXICO.—Several railway projects are being rapidly developed in Mexico, according to a press report from the city of Mexico, which states as follows: It has been received by a private cable message from London that Delfin Sanchez, the contractor on the International R. R., has consummated a loan for about $15,000,000 for the completion of the line to Acapulco, the Pacific coast terminus. The portion remaining to be built is 300 miles, and will give a transcontiental route across Mexico from Vera Cruz, on the gulf of Mexico to Acapulco. The Mexican government has a large force of men, numbering about 2,000, pushing the construction of the Tehuantepec Ry., and Col. H. Sampson, of Kansas City, has the work of completion on the Mexico, Cuernavaca & Pacific R. R. well under way. This line is also aiming at Acapulco, on the Pacific coast, and is a sharp rival to the Interoceanic for the west coast trade. The Mexican National Const. Co. is building from Colima to Guadalajara, on the Mexican Central, and this latter road is arranging for at least three extensions to its present system. An option for $130,000 is out for the purchase of the electric R. R. of the suburbs of the city of Mexico. The intending purchaser is the District Ry. Co. of the Mexico City Federal district, although another company is also after the Valley road, largely for the purpose of absorbing its valuable franchises for the right of way for a new road. The Metropolitan Belt Ry. Co., which includes Gen. Herman Strum, Col. W. J. Degress and others, is getting things in shape to build its line around the city of Mexico. This line will cost about $750,000. The government has granted a concession to Senores Guadalupe Guadauama and Meleslo Alcartara for the construction of a railway from Cazatdero, on the Mexican Central, to the station of Tepsongo, on the National. The cut-off line will be about 75 miles in length and will greatly lessen the connecting distance between the two roads.

COLOMBIA.—S. B. McConnio, New Orleans, La., has returned to this country from the United States of Colombia, S. A., where he has been superintending the construction of a railway from Carthagena to Calamar, 65 miles from the coast. A New Orleans paper states as follows: The road is built direct across a hilly country from the coast to the Calamar River, at Calamar. The road has been running from the coast to Turbaco, some distance in the interior, for the past two months. It has been longer in building than was expected, due to the fact that there has been a scarcity of labor, and it was found necessary to import labor from Jamaica. Work is now progressing rapidly, and it is expected that the road will be completed by the last of March or first of April. Mr McConnico has projected another road that will open up a large and fertile territory, and he desires to superintend the construction of a road through it if possible. The present road is being built by New York and Boston capitalists.

STREET AND ELECTRIC RAILWAYS.

EXETER, N. H.—It is reported that a Boston syndicate has offered to purchase the franchise and to give bonds to construct a street railway in this place within a year.

FALL RIVER, MASS.—The Fall River & Stone Bridge Electric Ry. Co. has voted to lay tracks from the state line to Tiverton. A franchise has been secured and the construction of the road will be commenced in the spring; distance, eight miles; capital stock, $100,000; Pres., D. P. Church; Treas., N. B. Church, both of Tiverton.

LOWELL, MASS.—The Boynton Bicycle R. R. Co. will petition for the right to construct a railway between Lowell and Boston, under the patents now owned by that company. The proposed road will extend from Lowell through Chelmsford, Billerica, Bedford, Burlington, Lexington, Arlington, Somerville and Cambridge, to Boston, and thence by way of Columbus Ave. to Washington St., through Dedham, Walpole, Foxboro and Attleboro; also a road from Boston to Beverly, in as near a straight line as the legislature shall permit, and connecting with the circut road; also a circuit road connecting said road through Charlestown and Haymarket Square with Quincy, along Atlantic Ave. and through such streets as may be designated by the mayor and aldermen of Boston, extending said road to the city of Brockton, and connecting Boston with other suburban cities and towns.

HARTFORD, CONN.—Press reports state that the Hartford & West Hartford Electric Ry. Co. has awarded the contract for building an electric railway from Parkville, a suburb of Hartford, to Charter Oak Park, through Elmwood to Newington, thence to New Britain, connecting with the New Britain electric road to Plainville. The company has also let a contract for a line from the present terminus of the Hartford St. Ry., in West Hartford, through Farmington to Unionville. The contracts call for the completion of the lines by April, 1894.

TRENTON, N. J.—The plans for the New Jersey Ry. Co., recently incorporated by Jos. H. Real, of Bloomfield; C. E. W. Smith, of Morristown; J. H. Baldwin, of Orange; Geo. S. Forbush, of Boston, and Maj. John Runk have been made public. The projected electric railway will commence at the Delaware River in this city and pass through Lawrenceville, Princeton, Kingston, Rocky Hill and East Millstone to Bound Brook, from whence branches lead to Somerville and Raritan on the west and New Brunswick on the east. Passing north from Bound Brook the line runs northeast to Westfield, passing through Dunellen, Plainfield and Fanwood. From Westfield a branch will run to Rahway, Elizabeth, Woodbridge, Boynton Beach and Perth Amboy, forming a short line from north Jersey and eastern Pennsylvania to the seashore. The line continues northeast from Westfield, passing through Springfield, Millburn, Wyoming, South Orange, Orange, West Orange, East Orange, Bloomfield, Montclair, and thence to Paterson, with a branch from Millburn to Irvington and Newark on the east and to Morristown on the west. Another branch extends from Montclair to Caldwell. The entire line has been surveyed. The right of way has been secured and the necessary franchises are assured. The line will be laid with 70 and 90-lb. steel rails and equipped with 34-ft. double motor cars of 30 HP. each. Power plants of 1,000 HP. each will be located at Trenton, Rocky Hill, Bound Brook, Westfield and Orange. The road will intersect both the Pennsylvania and Reading at Trenton, the Pennsylvania at New Brunswick, the Lehigh Valley, Reading and New Jersey Central at Bound Brook, the New Jersey Central at Plainfield and Westfield, the Morris & Essex at Millburn, South Orange, Orange and Montclair, the Delaware, Lackawanna & Western at Paterson, the New York & Greenwood Lake at Orange and Montclair, the Erie and the Susquehanna & Western at Paterson. The road will connect with Newark and Jersey City at South Orange, Orange and Bloomfield by electric railways now in operation, and thus form a through line from Trenton to New York, Paterson and Newark, and in connection with the proposed road in Pennsylvania, which runs along the Delaware River, from Trenton to Philadelphia by way of Bristol, will form a through line. This system will afford facilities for traveling from one station to the other on the steam roads which it crosses and will form a connection between Boston, New England and Trenton and the South by connecting with the New York & New England by way of the Erie and Poughkeepsie Bridge, saving expensive transfers and great loss of time at New York.

OXFORD, PA.—It is reported that S. M. Patterson, of the Pennsylvania Traction Co., is seriously considering the construction of a branch line to this place from the main line of the electric railway at Parkersburg, 15 miles distant.

SHAMOKIN, PA.—The Morrison Cove Electric Ry. Co. has been incorporated to build an electric railway from Roaring Springs to Woodbury and Hopewell, Bedford county; capital stock, $175,000; Pres., Emanual C. Hamilton.

BALTIMORE, MD.—It is reported that surveys and plans are about ready for the construction of the Baltimore & Washington Turnpike & Tramway Co.'s electric railway to Washington. Pres., David M. Newbold; Ch. Engr., Francis H. Hambleton.

PIKESVILLE, MD.—The Pikesville, Reisterstown & Emory Grove R. R. Co. has been incorporated by Geo. R. Webb, John Cowan, Oscar T. Crosby, Thos. I. Elliott, Reister Russel and others, of Baltimore, to construct an electric railway 12 miles in length from the Pikesville terminus of the Pimlico & Pikesville electric line through Reisterstown, along the Dover road to Glyndon, thence on the tracks of the Western Maryland R. R. to Reisterstown Ave., and on Reisterstown Ave., Central Ave., Dover road and Waugh Ave. to Emory Grove camp meeting grounds; capital stock, $250,000.

CULPEPER, VA.—The Culpeper, Rappahannock & Madison R. R. Co. has been formed to build an electric railway to Sperryville; capital stock, $100,000; W. P. Hill and S. R. Smith are interested.

TOLEDO, O.—The Toledo & Maumee Valley Ry. Co. has been incorporated to build an electric railway about 40 miles in length, having this city and Perrysburg as termini. The entire system is reported as to include over 200 miles of road in Northwestern Ohio, including that between Tiffin and Fostoria, now under construction; capital stock, $300,000; Wm. B. Taylor, J. D. Cork, G. G. Metzger, Parks Foster, Grant Williams.

CHICAGO, ILL.—The Columbia Construction Co. has been incorporated to build electric railways in the northern and northwestern portions of the city; capital stock, $2,000,000; D. H. Louderback, Pres. Chicago North Shore St. Ry. Co.; Samuel Insull, Pres. Chicago Edison Co.; Lewis Cochran.

DULUTH, MINN.—The City Ry. Co. has been granted a franchise for its proposed lines.

KANSAS CITY, MO.—The projected Merriam Park, Rosedale & Kansas City Electric Ry., noted last week, will be about five miles long and the construction is expected to begin in the spring. Pres., A. A. Pearson; Secy., E. C. Bartberger.

ST. LOUIS, MO.—The town of Kirkwood has granted a franchise for the St. Louis, Kirkwood & Meramec Highlands Air Line electric railway, projected by J. D. Houseman, Jr., Dr. John Pitman and others.

WESTPORT, MO.—The council has granted a franchise to the Kansas City Electric Ry. Co. to construct a double-track street railway from the terminus of the Summit St. line, southeasterly to the terminus of Grand Ave. Cable Ry., and thence south on Main and Oak Sts. to the city limits. W. W. Kendall is president of the new company, and Theodore S. Case is secretary. H. L. McElroy and Preston Roberts are directors. The capital stock is $50,000, which will be increased to $200,000 in January. The franchise provides that work must be begun within 4 mos. and the road completed within 8 mos. It is proposed to ultimately extend the line to Forest Hill cemetery and Waldo Park.

HAMILTON, ONT.—The directors of the Hamilton, Grimsby & Beamsville Electric Ry. have ordered 1,350 tons of steel rails. The ties are being received, and it is thought that this road, the construction of which has been talked of for about three years, is really to be built. The statement is made that it will probably be in operation by next July.

ELEVATED RAILWAYS.

PHILADELPHIA, PA.—Recent judicial decisions have put new life into the projected elevated railways in this city and it is thought probable that the construction of the lines will soon be resumed. It is stated that $6,000,000 has already been subscribed for the work. Both the Northeastern and Quaker City elevated railway companies had made good beginnings when the work was stopped last summer by injunctions. The Northeastern is estimated to have spent over $100,000 on Front St., where over a mile of foundations has been completed, extending from Norris St. to Girard Ave. and from Vine to Arch St. Between Arch and Race Sts. about 350 ft. of the elevated structure has been completed and is ready for the rails. The Quaker City has completed its structure on Belmont Ave. from Elm Ave. to the Pennsylvania R. R., and had applied to the board of highway supervisors for a permit to open Market St., when the injunctions were granted, and the board refused to act pending the settlement of the legal questions.

HIGHWAYS.

NEW YORK.—The citizens of Grand Gorge and Gilboa are planing the construction of a highway between the two places.——The committee on county roads of Erie county proposes to construct 195 to 220 miles of highways at an estimated cost of about $1,000 per mile, according to reports.

NEW JERSEY.—The council of Jersey City is considering plans for the proposed boulevard from Kill von Kull to Bergen county line, a distance of 14½ miles. The specifications call for a 36-ft. roadway of Telford macadam paving and a 16-ft. roadway of bridle path, with 4-ft. gutters paved with Belgian blocks; total estimate, $597,580.

WASHINGTON.—A contract for a five-mile extension of the Guide Meridian road from New Whatcom has been awarded to Anderson & Singleton, at $21,094. It is stated that the road is to be planked 16 ft. wide.

CALIFORNIA.—The supervisors of San Diego county have issued a call for a road convention to be held at San Diego, Jan. 9. Extensive road improvements are needed in the county, and as work cannot be done by general taxation without unduly increasing the tax rate, it has been proposed to issue bonds.

BRIDGES AND TUNNELS.

ALBANY, N. Y.—Bids are asked until Jan. 11 for building a wrought iron superstructure for bridge over the Erie Canal at Ford St., in the city of Rochester; rebuilding bridge over the Erie Canal at Ann St., Little Falls; rebuilding bridge over the Erie Canal at Bridge St., Amsterdam; and for building a lift bridge over the Erie Canal at Clinton St., Syracuse.

YONKERS, N. Y.—The board of estimates, New York, has appropriated $20,000 for the widening of the Croton Aqueduct arch over Nepperham Ave. The present arch is 16 ft. wide and it is proposed to widen it to 42 ft.

MONTCLAIR, N. J.—The township committee has instructed Jas. Owen, Engr., to make plans and secure estimates for an iron bridge on Upper Mountain Ave. The distance to be spanned is about 90 ft.

EASTON, PA.—The commissioners of Northampton county have awarded the contract for widening the Third St. bridge in this city to the Lehigh Valley Construction Co., at $26,393.

MOBILE, ALA.—Bids are asked until Jan. 15 for a steel roadway truss drawbridge over Three-Mile Creek. Price Williams, Jr.

COLUMBUS, O.—The county commissioners will receive bids until Jan. 31 for a bridge over the canal at Lockbourne; length of span, 78 ft.; roadway, 18 ft. in clear.

HOLLYWOOD, ILL.—It is stated that a bridge will soon be constructed over the Desplaines River between this place and Riverside, and one over the Little Desplaines between this place and Grossdale.

RED WING, MINN.—An election will be held Feb. 8 to vote on an issue of bonds for $70,000 for a wagon bridge over the Mississippi River.

COLUMBIA, TEX.—Plans for a bridge across the Brazos River at this place have been prepared by G. P. Q. Sadler.

WATER-WORKS.

NEWPORT, ME.—The town has voted to contract with the Newport Water Co. for 15 hydrants for 20 years, at $40 a year per hydrant. The company will award contracts for works at once, according to reports.

BELCHERTOWN, MASS.—It is reported that W. Orlando has offered to construct works for $10,000.

BOSTON, MASS.—The contract for a high-duty 10,000,000-gallon pumping engine has been awarded to the Geo. F. Blake Mfg. Co. The bids were published last week. The engine will be provided with an automatic Corliss valve gear and work under a steam pressure of 160 lbs. per sq. in., and we are informed that this is the fifth engine of this type that this company has secured a contract for within the last month.

CAMBRIDGE, MASS.—The council has appropriated $300,000 for improving the supply at Stony Brook and for a high-service reservoir, pump, etc., as recommended by the board and previously noted in these columns.

FALL RIVER, MASS.—The contract for a new pumping engine, which has been under consideration for several months, has been awarded to M. T. Davidson, Brooklyn, N. Y., at $22,400. This was purchased from a loan of $200,000 authorized last spring, the expenditure to be extended over three years.

MARLBORO, MASS.—The question of a stand-pipe is being considered.

MEDFORD, MASS.—Bids have been opened for $72,000 of water bonds.—The council has concurred in an appropriation of $100,000 for water bonds.

NORTHAMPTON, MASS.—The mayor has recommended the construction of a 100,000,000-gallon reservoir estimated to cost about $60,000.

SALEM, MASS.—The council has adopted the report for an increased supply, referred to last week, the estimated cost being $100,000.

NEW CANAAN, CONN.—The New Canaan Water-Works Co. is negotiating for a dam site for a proposed reservoir.

SOUTHPORT, CONN.—T. H. McKenzie, Southington, is designing works for this place and Fairfield, for the Southport Water Co.

BABYLON, N. Y.—The Sumpawams Water Co. proposes to increase its capital stock from $25,000 to $40,000. Supt. B. B. Wood.

CANARSIE, N. Y.—The Flatlands Water Supply Co. has been incorporated by H. H. Adams, W. A. Furey, H. A. Gerhardt and others of Brooklyn; capital stock, $10,000.

DOWNSVILLE, N. Y.—It is reported that works will be put in next year.

FREEPORT, N. Y.—An election will be held Jan. 9 to vote on an appropriation for works estimated to cost $40,000. The plans include 75 fire hydrants and five miles of pipe line. An appropriation of $5,000 for fire wells for outlying districts will also be voted upon.

PERRY, N. Y.—The trustees are considering a petition for a franchise, it is reported, the supply to be from Silver Lake.

BLOOMFIELD, N. J.—The contract with the Orange Water Co., referred to last week, is reported to have been renewed for six months and estimates are being prepared for a supply from the mains of the East Jersey Water Co.

IRVINGTON, N. J.—The Irvington Water Co. has filed a bond for $2,500 as a guarantee that 2½ miles of mains will be laid within five months, the supply to come from the Summit reservoirs.

WESTWOOD, N. J.—Chas. B. Brush, Ch. Engr. Hackensack Water Co., has reported that it would cost $35,000 to build an extension of the works to this place, which the company has offered to make for $2,500 per year. The proposition is being considered. John J. Bate, Chn. Com.

ALLEGHENY, PA.—The council has voted to advertise for bids for the proposed new plant, according to three different plans.

PITTSBURG, PA.—The director of public works is reported as stating that he will recommend the purchase of two new pumps and the construction of an additional reservoir.

ABERDEEN, MD.—C. M. Johnson, Baltimore, is reported as preparing plans for works at this place.

BALTIMORE, MD.—The water board will receive bids until Jan. 8 for 575 tons 1½ to 10-in. cast iron pipe, castings, brass stops, etc. Wm. J. Kenly, Act. Ch. Engr.

ALEXANDRIA, VA.—The Alexandria Water-Works Co. has been restrained by temporary injunction from supplying the village of West End, outside the city limits.

YORKVILLE, S. C.—The legislature has been petitioned for authority to issue bonds for completing and equipping the works.

MONROE, LA.—The Monroe Water-Works & Light Co. has awarded a contract for a 900,000-gallon reservoir to furnish direct pressure in case of fire.

MADISONVILLE, KY.—It is reported that the question of constructing works is being discussed.

MOUNT STERLING, KY.—The council has refused to grant an extension of time for the construction of works, and the work will be commenced at once, according to reports.

SHELBYVILLE, KY.—Geo. C. Morgan, Chicago, has been engaged to prepare plans.

ATTICA, O.—The question of works and electric lights are being considered, according to reports.

HAMILTON, O.—About 4,000 ft. of 8-in. main will be put in to secure a supply for the East Hamilton manufacturers.

MIDDLETOWN, O.—Bids are asked until Jan. 5 for $10,000 of 5% water bonds. J. W. Bonnell, Cy. Clk.

NAPOLEON, O.—Bids are asked until Jan. 9 for $60,000 of water-works and electric light bonds. C. E. Reynolds, Vil. Clk.

EVANSVILLE, IND.—The committee has recommended that prizes for best plans for works be awarded for plans Nos. 3, 17 and 1.

LADOGA, IND.—The question of constructing works is being considered.

CHEBOYGAN, MICH.—A supply has been recommended from the lake, the estimated cost for a daily supply of 5,000,000 gallons being $41,180.

GRAND RAPIDS, MICH.—The board of public works will ask for a new pump for the hill districts.

LANSING, MICH.—The city has contracted with the Holly Mfg. Co., Lockport, N. Y., for a 5,000,000-gallon Gaskill high-duty pumping engine, to be in operation by May, 1894.

CHICAGO, ILL.—The Illinois Pure Water Co. has been incorporated by Ira C. Wood, H. M. Carter and E. O. Nichols; capital stock, $1,500,000.—The D. & L. Caledonia Spring Water Co. has been incorporated by J. H. Doran, H. L. Lagelier and J. J. McClellan; capital stock, $50,000.

HOLLYWOOD AND GROSSDALE, ILL.—Village trustees have been elected and active steps will now be taken to secure works.

JACKSONVILLE, ILL.—Plans have been made for a dam 500 ft. long and 17 ft. high; capacity of reservoir, 53,000,000 gallons; cost of dam, $18,000 to $20,000.

MADISON, ILL.—It is reported that the Niedringhaus syndicate has been refused an extension of time in which to secure a supply for the village.

PONTIAC, ILL.—It is reported that this city will have works to cost $31,000.

WENONA, ILL.—The council is being urged to secure works.

AUSTIN, MINN.—The contract for drilling a well for the water-works has been canceled, the work not having been commenced according to the agreement.

MINNEAPOLIS, MINN.—The committee will readvertise for valves.

ST. LOUIS, MO.—The contract for boilers for the low service pumping station at Chain of Rocks has been awarded to the National Water Tube Boiler Co., New Brunswick, N. J., at $19,868.

AUBURN, NEB.—An election will soon be held to vote on an issue of bonds for $20,000 for works.

TRENTON, NEB.—The citizens have voted, 78 to 11, in favor of works.

ARLINGTON, TEX.—The Arlington Water-Works Co. has been organized; capital stock, $10,000; Pres., Dr. S. C. Page; Secy., A. W. Fife. Steps will be taken at once to put in works, according to reports.

NORMAN, OKLA.—An election will be held Jan. 8 to vote on a proposed issue of bonds for works.

BOULDER, COLO.—The council has rejected all bids for the proposed extensions and new specifications will be prepared.

SEATTLE, WASH.—The superintendent has recommended that steps be taken to purchase a 2,000,000-gallon pump for the Broadway station and a 10,000,000-gallon pump for the Lake Washington station.

SPOKANE, WASH.—The council has advertised for new bids for the proposed works, the bids to have been received last week.

ALAMEDA, CAL.—The trustees are reported as trying to secure a new supply.

SAN DIEGO, CAL.—The Pine Valley Consolidated Water & Land Co. has been incorporated; capital stock, $4,000,000.

COOKSHIRE, QUE.—Reports state that bonds have been sold for works, which will be constructed as early as possible in the spring.

ARTESIAN WELLS.

ONEIDA, NEB.—Press reports state that this town is about to issue bonds for the purpose of sinking an artesian well.

IRRIGATION.

BEEVILLE, TEX.—Greathouse & Taylor have been awarded a contract for an irrigation plant designed for an 800-acre farm near Mathis Station. Horizontal centrifugal pumps, stationary engine and boiler of about 40 HP. will be used. Frank S. Taylor, Engr.

FRESNO, CAL.—Reports from this city state that T. L. Reed, Reedley, has been awarded the contract for the construction of the Sunset irrigation canal and that the work will be commenced at once. The district comprises 300,000 acres of land and 282 miles of canals have been surveyed. The work has been under consideration for several years and about two years ago $2,000,000 of bonds were voted for the construction. The water will be taken from King's River below Kingsbury. Ch. Engr., J. S. Eastwood.

PHOENIX, ARIZ.—Press reports state that work on the South Gila dam, after a suspension of six months, is about to be resumed with a force of 600 men. The work will cost in excess of $1,000,000 before completion. The dam will make a lake 13 miles long, and it is intended to irrigate 160,000 acres of land.

BOISE CITY, IDAHO.—Press reports from this city state as follows: D. C. Groesback, a farmer living in Boise Valley, is in this city to secure engineers to survey an irrigation canal. The water is to be taken from Boise River. It will irrigate thousands of acres, now arid land, known as the North Beach. About 40 farmers are engaged in the enterprise. The canal will be 25 miles long. Those who take up land under the proposed canal will be allowed to work out a perpetual water right, and it is regarded as a valuable plan for the settlers. No foreign capital will be employed and the canal will be owned and controlled by the farmer stockholders.

PAYETTE, IDAHO.—The Payette & Weiser Ditch Co. has a corps of surveyors in the field making locations for its proposed canal, according to reports. Men and teams are also at wrok excavating along the line.

NEW COMPANIES.—Victor Reservoir Co., San Bernardino, Cal.; $2,500,000; to erect a dam at Victor Narrows, on the Mojave River, 150 ft. in height, impounding a lake of water nine miles long and about three miles wide, the water to be used in irrigating about 200,000 acres of land on the Mojave desert.—North Loup Irrigation & Improvement Co., North Loup, Valley Co., Neb.; $50,000; S. S. Smith, Hiram N. Davis, A. H. Babcock, S. McClellan and others.—Waterloo Ditch & Power Co., Waterloo, Linn Co., Ore.; $6,000; R. R. Humphrey, O. Jennings, Geo. Medley.—Piedmont Irrigation & Domestic Water Assn., Los Angeles, Cal.; $25,000; F. C. Firley, S. S. Strong, Pomona; R. B. Brown, J. A. Packard, Lordsburg; O. B. Sheldon, North Pomona—Irrigation Loan & Trust Co., Hutchinson and Salina, Kan.; $50,000; F. A. Casner, Lincoln; F. W. Casner, Hutchinson; T. W. Casner, Salina.

SEWERS.

BOSTON, MASS.—The superintendent of streets has awarded ten contracts, intended to give work to 400 unemployed men.

CAMBRIDGE, MASS.—The council has appropriated $75,000 for connecting the sewers with the metropolitan system.

SPENCER, MASS.—It is reported that plans are being prepared by Nathan E. Craig, Tn. Engr., for a system for the better disposal of the sewage of the town, according to instructions voted at the last annual meeting.

WOBURN, MASS.—The council has appropriated $25,000 for sewers.

JAMESTOWN, N. Y.—Wm. B. Landreth, Cy. Engr., informs us that the sewer work recently noted will be readvertised.

PATERSON, N. J.—The contract for the Lynn St. sewer was awarded to John Collins at $6,273; highest bid, $14,315.

ALLEGHENY, PA.—Bids will soon be asked for 12 and 9-ft. sewers and for several smaller ones; estimated cost, about $400,000.

BRADDOCK, PA.—Wm. Smith, Boro. Engr., has been directed to prepare plans for a system of sewerage for the borough.

HARRISBURG, PA.—An ordinance providing for draining Paxton Creek is being discussed; estimated cost, $300,000.

ATLANTA, GA.—Bids will be received at the office of the city clerk until Jan. 15 for constructing brick and pipe sewers for 1, 3 and 5 years. R. M. Clayton, Cy. Engr.

CLARKSVILLE, TENN.—It is proposed to issue bonds to complete the system.

HAMILTON, O.—L. P. Clawson has been elected president and Samuel Beeler secretary of the commission.

TOLEDO, O.—Ordinances have passed the council for constructing brick sewers in several streets. About 90 bids were received for seven sewers; total length, 7,500 ft.; estimated cost, about $25,000.

HUNTINGTON, IND.—The council is considering plans for a system estimated to cost about $100,000.

BIG RAPIDS, MICH.—Plans have been adopted for a system estimated to cost about $10,000.

MILWAUKEE, WIS.—New bids are asked for the first section of the new tunnel sewer. The work includes 500 ft. of 10-ft. sewer and 700 ft. of ditch, and the bids recently received were published in our issue of Nov. 30. G. H. Benzenberg, Cy. Engr.

WHITEFISH BAY, WIS.—Plans for a system are being prepared by Gustav Steinhagen; estimated cost, $82,000.

DAVENPORT, IA.—Thos. Murray, Cy. Engr., informs us that the city will not order the construction of sewers or paving for several months.

SIOUX CITY, IA.—Bids are asked until Jan. 16 for $50,000 of sewer bonds; also for constructing sewers, as stated in our advertising columns.

RED WING, MINN.—The committee has been directed to investigate the feasibility of constructing sewers in several streets, the work to be commenced at once.

SEATTLE, WASH.—The city has sold the $975,000 of bonds authorized last June, including $95,000 of sewer tunnel bonds and $250,000 of sewer bonds. About 300 men are now employed on sewer and street work.

COOKSHIRE, QUE.—It is reported that the construction of a system will be commenced as soon as possible in the spring.

KINGSTON, ONT.—Dr. R. T. Walkmen, Chn. Bd. of Health, has directed the warden of the penitentiary to construct an intercepting basin to prevent the discharge of sewage into the bay. The sewage will be used for fertilizing purposes.

STREETS.

BROOKLYN, N. Y.—Bids are asked until Jan. 11, 12 and 16 for paving with cobblestones, one street at each date. J. P. Adams, Comr. Cy. Wks.

BUFFALO, N. Y.—Bids have been received for about $130,000 worth of paving, 10 contracts, the bidders being the Barber Asphalt Paving Co., German Rock Asphalt Paving Co., Buffalo Paving Co., P. B. McNaughton, L. Hittrick, Jr., and E. H. Rogers.

NEW YORK, N. Y.—Bids are asked until Jan. 9 for grading, flagging, etc., in two streets. L. J. Heintz, Comr. St. Impvts., Wards 23 and 24.

NIAGARA FALLS, N. Y.—The city is discussing paving for next season.

BRIGANTINE, N. J.—Bonds for $30,000 have been sold for improving the streets.

LANCASTER, PA.—S. C. Slaymaker, Cy. Engr., informs us that the council has passed an ordinance appropriating $300,000 for paving, macadamizing and sewers, $60,000 to be expended each year for five years. The ordinance is subject to the approval of the voters at the February election, and if approved no work can be commenced before June 1.

PHILADELPHIA, PA.—Bids are asked until Jan. 10 for repairing and grading streets. J. H. Windrim, Dir. Pub. Wks.

CINCINNATI, O.—The board of administration will receive bids until Jan. 12 for paving Edgewood Ave. with brick.

COLUMBUS, O.—The estimated cost of macadamizing 8,800 ft. of roadway in Franklin Park is $18,735.

IRONTON, O.—It is reported that Third St. is to be paved at a cost of about $60,000; the county and the street railway company each to bear one-third of the expense and the citizens and the city each one-sixth.

HAUGHVILLE, IND.—Bids are asked until Jan. 10 for grading and graveling Bismarck Ave. John N. Dugan, Clk.

KANSAS CITY, MO.—The board of public works has issued a circular inviting contractors to compete for asphalt paving contracts in this city. It states that 10 streets, 48,163.80 sq. yds., were paved with asphalt during the year ending April 11, 1893, at a cost of $124,117, being $2.25 to $2.80 per sq. yd., and that since then 15 streets, 111,735 sq. yds., have been paved

with asphalt at a cost of $288,101, and it is now proposed to pave 13 streets, 176,980 sq. yds., during the coming year, most of which work will probably be done with asphalt.—Bids will be received until Jan. 10 for sidewalks. John Donnelly, Cy. Engr.

ELECTRIC LIGHT AND POWER.

RUTLAND, VT.—The Marble City Electric Co., recently incorporated, has completed plans for its plant, including three boilers, three engines and seven dynamos, according to reports.

HAVERHILL, MASS.—The aldermen have passed the municipal electric lighting ordinance, and it is stated that the question will now be submitted to a vote of the citizens.

CANTON, O.—The council has decided to ask for authority to issue $60,000 in bonds for an electric light plant.

mond, $23.25 for 12 and 8-in. and $22.75 for 6 and 4-in.; John Fox, $22.69; Radford Pipe & Foundry Co., $22.69; Jackson & Woodin Mfg. Co., $23 for 12-in., $23.50 for 8 and 6-in., $23.50 for 4-in.; Warren Foundry & Machine Co., $23.99; Warren, Wood & Co., $24.70.

STREET REPAIRS.—Philadelphia, Pa.—Contracts for repairing streets during the coming year have been awarded at the following prices: For repairs to streets paved with asphalt, at $1.25 and $2 per sq. yd.; vitrified brick, $5; asphalt blocks, $1.50.

SEWERS.—Cincinnati, O.—We are informed that the board of administration opened bids Dec. 18 for a sewer in Badgley Run and Kirby Road, and Dec. 25 for a sewer in Crawfish Creek with a 54-in. branch from Eastern Ave. to Woodbridge Place. The itemized bids are published below, the total bid in each case being given beneath the name of the bidder.

Bids for a Sewer in Crawfish Creek, Cincinnati, O.

Quantities.	J. V. Rose, Jr. $27,500.	John F. Deters. $30,645.	Evan Evans. $28,612.	W. C. Dowson. $30,772.	Henry Frank. $32,661.	P. N. Jonte. $23,698.	H. McErlean. $26,854.	P. Murray & Sons. $23,250.	J. J. Shipman. $18,044.	J. M. Peter. $28,561.	Samuel S. Kase. $31,196.	George P. Walker. $31,124.	D. Fitz & Son. $27,315.	Wilson & Strack. $31,564.
11-ft. brick 1,500 lin. ft., at	11.40	16.35	16.38	25.60	15.45	14.50	16.00	16.00	17.50	16.25	13.50	15.00	18.50	14.05
11-ft. " (tunnel) 200 lin. ft., at	30.00	38.00	32.00	36.00	32.00	43.75	35.00	47.93	27.00	40.00	18.00	35.00	30.00	20.00
2½-ft. " 100 lin. ft., at	3.00	2.60	2.00	1.90	1.75	1.75	3.00	1.50	2.00	1.47	2.20	1.50	2.75	1.20
3-ft. " 200 " "	3.75	3.00	2.65	2.10	2.65	2.25	3.50	2.50	2.27	2.63	2.75	2.25	3.25	2.27
4-ft. " 100 " "	4.05	3.50	3.65	2.70	3.00	2.75	4.00	3.00	3.00	3.25	3.15	3.10	3.50	2.65
4½-ft. " 1,000 " "	4.75	4.00	4.64	3.06	3.79	3.25	5.00	4.00	7.50	3.52	3.70	3.20	4.50	2.99
5-ft. " 1,800 " "	10.26	10.15	8.40	8.25	8.63	8.25	10.00	15.90	11.50	10.10	8.40	8.75	8.75	7.71
9-ft. " 1,100 " "	12.45	10.90	8.90	9.72	9.77	9.00	11.00	16.90	12.50	12.18	9.30	9.25	9.50	8.55
10½-ft. " 600 " "	14.00	14.85	16.12	14.25	14.45	14.00	13.00	12.50	14.50	16.25	13.10	14.90	15.00	13.52
12-in. pipe. 100 " "	.38	1.00	.85	.30	.75	.50	1.00	.75	.25	.52	.60	1.00	1.00	.33
18-in. " 100 " "	.75	1.50	1.75	.79	1.25	1.00	1.25	1.25	.90	.82	.90	1.50	1.60	.70
24-in. " 100 " "	1.50	2.00	2.00	1.36	2.00	1.50	2.00	1.75	1.25	1.75	1.20	2.50	1.50	1.50
6-in. slan's, 500, at	.21	.50	.25	.15	0.30	.25	.40	.30	.50	.25	.15	.30	.40	.30
Manho'es, 30, at	21.00	25.00	25.00	17.00	35.00	20.00	30.00	25.00	20.00	20.00	30.00	20.00	18.00	32.00
Piling, 3,000 lin. ft., at	.27	.25	.20	.10	.30	.35	.35	.33	.40	.25	.28	.35	.30	.28
Rubble masonry, 8,000 cu. yds.	3.50	4.00	3.60	1.19	3.95	3.25	4.50	1.25	1.60	4.00	3.50	4.00	3.75	3.60
Concrete, 2,500 cu. yds.	3.25	2.00	3.50	.50	3.50	3.25	4.00	1.25	1.00	3.00	3.00	4.00	3.50	3.00
Timber foundations, 120 M ft., at	20.00	10.00	17.00	.01	24.00	20.00	24.00	20.00	20.00	22.00	2.00	25.00	20.00	10.00
Excavation, 33,000 cu. yds., at	.35	.40	.35	.48	.55	.45	.40	.40	.40	.40	.47	.50	.65	.40

Bids for a Sewer in Badgley Run and Kirby Road, Cincinnati, O.

Quantities.	P. Gleason. $139,522.	P. Murray & Son. $135,274.	D. Fitz & Sons. $137,488.	M. T. Flynn. $134,674.	John Bohn. Informal.	J. V. Rose, Jr. $136,137.	H. Rumbel & Bro. $132,913.	P. M. Jonte. $137,362.	Evan Evans. $134,647.	H. Dieckmeier. $135,602.	J. M. Peter. $139,351.	W. C. Dowson. $129,908.	H. Frank. $135,698.	B. D. Parton. $133,366.	Wilson & Strack. $134,104.	Sam. Struse. $141,561.	T. J. Peter. $131,895.	Patterson & Shipman. $121,013.	Geo. P. Walker. $143,865.
13½ ft. brick, 3,750 lin. ft., at	$18.75	$27.00	$21.00	$17.50	$18.00	$16.50	$16.00	$23.00	$17.00	$16.50	$25.70	$18.00	$16.48	$19.00	$15.62	$19 99	$21.00	$13.75	$19.00
3½ " " 100 " " "	4 10	4.00	5.00	2.50	4.00	2.00	3.75	2.50	3.00	4.00	3.00	2.29	2.79	3.26	2.19	3.50	3.50	3.00	3.00
6-in. pipe, 800 lin. ft., at	.30	.50	.50	.40	1.00	.35	.40	.25	.30	.30	.40	.90	1.00	.16	.15	.40	.60	.25	.50
12 " " 100 " " "	.40	.75	.75	1.00	2.00	.70	.85	.50	.85	.80	.60	.75	1.00	.40	.35	.80	1.00	.40	1.00
18 " " 100 " " "	1.00	1.25	1.00	1.25	....	1.00	1.25	1.00	1.25	1.00	1.25	1.00	1.25	.75	.65	1.20	1.50	.90	1.50
24 " " 200 " " "	2.00	2.00	2.00	2.00	3.00	1.50	2.25	1.50	2.50	2.40	1.50	1.37	2.50	1.40	1.65	2.10	2.50	1.30	2.50
Plants, 350	.20	.30	.50	.50	1.00	.30	.40	.25	.15	.40	.20	.15	.50	.25	.30	.25	.30	.75	.30
Manholes, 12	20.00	25.00	15.00	30.00	20.00	21.00	15 00	20.00	20.00	22.00	10.00	17.00	40.00	35.00	35.00	30.00	40.00	24.00	20.00
Masonry, 15,000 cu. yds.	4.00	1.00	3.50	3.75	4.00	3.50	3.90	1.00	3.50	3.90	4 00	3.49	3 15	3.00	3 65	3.50	4.00	3.75	3.70
Concrete, 2,000 " "	4.00	3.35	3.40	4.00	3.50	4.25	3.25	3.40	4.00	3.50	3.75	3.15	1.00	3.20	3.20	3.50	3.70	3.70	3.70
Timber, 380 M. ft. B. M.	15.00	20.00	10.00	24.00	25.00	24.00	20.00	21.00	21.00	22.70	.01	25.00	20.00	1.00	22.00	.01	20 00	24.00	24.00
Excavation, 40,000 cu. yds.	.43	.50	.38	.35	.45	.60	.40	.40	.56	.40	.00½	.30	.4⁸	.30	.35	.7⅛	.48	.35	.50

LOGANSPORT, IND.—The city has received an offer of a plant of 180 arc and 1,000 incandescent lights, a 180-HP. engine, etc., for $35,000, according to reports.

CHICAGO, ILL.—The contract for putting in the electric light plant into the new Champlain Bldg., this city, has been awarded to Louis K. Comstock, Monadnock Bldg. The building is 14 stories high, and 3,500 lights will be installed.

HOLLYWOOD AND GROSSDALE, ILL.—It is reported that an electric light plant will soon be put in.

TAMA, IA.—This city and Toledo will soon have electric lights and an electric railway, it is said.

ST. CHARLES, MO.—The council has decided to purchase a 50-light dynamo for the electric light plant.

SPRINGFIELD, MO.—An election has been called for Jan. 16 to vote on an issue of bonds for $100,000 for a municipal plant, for which it is proposed soon to prepare plans.

NEW COMPANIES.—United States Wenstrom Electric Co., Jersey City, N. J.; $30,000; Ben. Blum, Chas. S. Cowan, New York; J. S. de Levy, South Lakewood, N. J.——New Decatur (Ala.) Natural Gas, Petroleum & Mining Co.; Freehold, N. J.; $100,000; Thos. Rutter, Jas. Swan, C. Y. Kent, New York; A. C. Hartshorne, Freehold; J. D. Probst, Englewood.——Prairie City Electric Co., Madison, Wis.; $5,000; W. R. Thomson, A. L. Helman, S. N. Bisbee.——Pontiac Standard Lighting Co., Pontiac, Mich.; $30,000.——Northwestern Telephone & Electric Co., Milwaukee, Wis.; $50,000; A. B. Ferdinand, H. C. Dodge, E. W. Spencer.——Waterloo Ditch & Power Co., Waterloo, Linn Co., Ore.; $6,000; operate electric plant, etc.; R. R. Humphrey, O. Jennings, J. B. Wirt.

CONTRACT PRICES.

PIPE.—Milwaukee, Wis.—A contract for 3,000 tons of 10 to 3-in. cast iron pipe has been awarded to the Addystone Pipe & Steel Co., Cincinnati, at $19.85 per ton.

Minneapolis, Minn.—The contract for cast iron pipe for use during 1894 has been awarded to Dennis Long & Co., Louisville, Ky., at $20.47 per ton of 2,000 lbs., and that for special castings to the Northwestern Foundry Co., Minneapolis, at 2 cts. per lb.

Jersey City, N. J.—The following bids have been received for 100 lengths of 12-in. cast iron pipe, 1,000 lengths of 8-in., 500 lengths of 6-in. and 100 lengths of 4-in. pipe: McNeal Pipe & Foundry Co., $21.50 per ton of 2,240 lbs.; R. D. Wood & Co., $22.20; J. Drummond, $23.25 for 12 and 8-in. and $22.75 for 6 and 4-in.; John Fox, $22.69; Radford Pipe & Foundry Co., $22.69; Jackson & Woodin Mfg. Co., $23 for 12-in., $23.50 for 8 and 6-in., $23.50 for 4-in.; Warren Foundry & Machine Co., $23.99; Warren, Wood & Co., $24.70.

STEEL RAILS.—Press reports state that a contract for 3,000 tons of steel rails for the proposed Wascassett & Quebec R. R., in Maine, has been awarded at $23 per ton.

PIPE LAYING.—Sioux City, Ia.—The contract for laying water pipe to the Standard Oil Co.'s plant has been awarded to Nels Nyatrom at the following prices: 74½ tons of 12-in. pipe, at $38; 35½ tons, of 8-in. at $38; 1,032 lbs. of 4-in., at $38 per ton; one 12-in. valve, at $55; one 8-in. valve, at $35; seven 6-ft. hydrants, at $45 each; 6,872 lbs. specials, at 3½ cts.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

CITY HALL.—Newton, Mass.—The city is considering the question of a new city hall, estimated to cost about $500,000.

STEAM ROAD ROLLER.—Cincinnati, O.—The park commissioners will receive bids until Jan. 9 for a 10 to 15-ton steam road roller.

BOILERS.—San Francisco, Cal.—The new city hall commissioners will receive bids until Jan. 27 for two 75-HP. boilers. J. J. McCarty, Secy.

DREDGING.—Galveston, Tex.—Bids will be received at the U. S. Engineer Office until Jan. 20 for dredging in the Trinity River. Maj. A. M. Miller, U. S. A.

STREET SPRINKLING.—Nashville, Tenn.—The board of public works will receive bids until Jan. 9 for sprinkling about 60 miles of streets, the contractor to furnish wagons, teams and drivers.

PARK BONDS.—Cincinnati, O.—The park board will petition for authority to issue $100,000 of bonds each year for five years.

Cleveland, O.—The city auditor will receive bids until Jan. 11 for $300,000 of 4% park bonds.

PARK IMPROVEMENTS.—Cleveland, O.—The park commissioners are planning to spend $1,097,000 next year, including the following: Buildings and bridges, $80,000; grading, paving and sewerage, $35,000; fountains and fences, $20,000; land, $550,000.

Buffalo, N. Y.—The city authorities are reported as employing 1,000 men in breaking stone to be used for park roads, etc.

STREET CLEANING AND GARBAGE DISPOSAL.—Philadelphia, Pa.—We are informed that the following contracts have been awarded: Cleaning streets, etc., and removing ashes, Wilson & Vare, $111,999; Peoples & Josephs, $164,900; K. & D. Dooley, $33,900; Timothy Dorney & Son, $100,974; David M. Mahon, $78,933; Geo. W. Ruch, $62,889. Removal and disposal of garbage and combustible waste, American Incinerating Co., $64,879; Philadelphia Chemical Incinerating Co., $60,000; K. & D. Dooley, $33,000; Edward Gannon, $70,000; Philadelphia Chemical Incinerating Co., $65,000.

INDUSTRIAL NOTES.

THE HEATH RAIL JOINT CO., of Superior, Wis., has several large orders on hand, and has made several improvements in its plant.

THE IRON CAR CO., of Huntingdon, Pa., which has succeeded the Iron Car Equipment Co., is reported as intending to resume work shortly.

THE MICHIGAN PENINSULAR CAR CO., of Detroit, Mich., has an order for 500 coal cars for the New York, Ontario & Western, and an order for 100 box cars and 200 double-deck stock cars for the Chicago & Northwestern.

THE MOUNT VERNON CAR MFG. CO., of Mount Vernon, Ill., is building a number of ventilated fruit cars of 60,000 lbs. capacity for the Florida Central & Peninsular. They are equipped with Westinghouse brakes and the Buckeye automatic coupler.

ROBERT WETHERILL & CO., of Chester, Pa., have a contract for eight large engines, with boilers, cable driving pulleys and other plant for the new power houses of the Philadelphia Traction Co.

THE STANLEY ELECTRIC CO., of Pittsfield, Mass., has the contract for a 400-HP. multiphase dynamo to be used in a power transmission plant from Indian Orchard to Springfield, Mass. The dynamo will be run by water power and the current transmitted will be used for electric lighting.

THE CLAYTON AIR COMPRESSOR WORKS, of New York, N. Y., report their Brooklyn shops working full time and full capacity. They have recently taken out several patents on a new triple compound high pressure air or gas compressor, used largely by manufacturers of carbonic acid gas.

MESSRS. C. B. COLBY AND W. H. COLBY have opened an office at 328 Chestnut St., Philadelphia, as general inspectors of iron and steel, embracing structural work, track material, boiler and ship plates, etc. Mr. C. B. Colby has been Eastern manager for G. W. G. Ferris & Co. for six years, and Mr. W. H. Colby has been connected with iron and steel manufacture, construction and inspection for 20 years.

NEW COMPANIES.—Buffalo Oil & Gas Co., Pittsburg, Pa., to supply oil and gas to Pittsburg; $15,000; Treas., Fred. J. Osterling, 7th Ave., Pittsburg. Subjacent Electric Wires Traction Co., Chicago; $1,000,000; Chas. M. Hill, Chas. Rose, Bloomington Pressed Brick Co., Bloomington, Ill.; $32,000; Eleanor Dunlap, J. M. Elder. Chicago Mutual Sand & Gravel Co., Chicago; $300,000; W. Know Haynes, F. J. Hoyt. Wisconsin Washed Gravel Co., Chicago; $250,000; Geo. H. Taylor, B. W. Viers. Illinois Pure Water Co., Chicago, Ill.; $1,500,000; Ira C. Ward, Edw. C. Nichols. Dean, Huef, Brooks & Moneuse Co., Chicago; $150,000; John S. Brown, E. M. Jones; to manufacture boilers and furnaces. Columbia Construction Co., Chicago, Ill.; $2,000,000; D. H. Lauderbach, J. L. Cochran and Samuel Insull. Illinois Refuse Crematory Co., Chicago, Ill.; $600,000; R. R. Bradley, Philip S. Post, Jr., and Hamilton Anderson. Cherryvale Construction Co., Cherryvale, Kan.; $25,000; James O'Leary, G. F. Woodland and M. J. Templeton. American Machine Co., Pawtucket, R. I.; $600,000; James C. Potter.

METAL MARKET PRICES.

RAILS.—New York: $24.80 at eastern mills and at tidewater, Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $12 to $13 for iron and $7.25 to $10 for steel.

TRACK MATERIAL.—New York: Angle bars, 1.25 to 1.4 cts.; spikes, 1.7 to 1.9 cts.; track bolts, 2.1 to 2.4 cts with square and 2.3 to 2.5 cts. with hexagon nuts Chicago: Angle bars, 1.55 to 1.6 cts.; spikes, 1.9 to 1.95 cts.; track bolts, 2.55 to 2.6 cts. with hexagon nuts.

FOUNDRY PIG IRON.—New York: $13 to $14.50. Pittsburg: $11.25 to $12. Chicago: $12 to $13.50.

LEAD.—New York: 3.25 cts. Chicago, 3.1 cts.

NAILS.—Pittsburg: $1.10 to $1.30 for wire, 95 cts. at mill for cut.

STRUCTURAL MATERIAL.—New York: Beams, 1.65 to 2.25 cts.; channels, 1.75 to 2 cts.; angles, 1.55 to 1.75 cts.; tees, 1.75 to 2 cts.; universal mill plates, 1.5 to 1.65 cts.; steel plates, 1.45 to 1.6 cts. for tank, 1.6 to 1.9 cts. for shell, 1.9 to 2.15 cts. for flange; 2.25 to 2.8 cts. for firebox. Pittsburg: Beams, 1.45 to 1.6 cts.; channels, 1.45 to 1.6 cts.; angles, 1.45 to 1.5 cts.; tees, 1.7 to 1.75 cts.; universal mill plates, 1.45 to 1.5 cts.; steel plates, 1.35 to 1.37 cts. for tank, 1.55 to 1.6 cts. for shell, 1.65 to 1.75 cts. for flange, 1.85 to 1.95 cts. for ordinary firebox and 2 to 2.15 cts. for railway firebox. Chicago: Beams, 1.65 to 1.75 cts.; channels, 1.65 to 1.75 cts.; angles, 1.6 to 1.65 cts.; tees, 1.9 to 2 cts.; universal plates, 1.6 to 1.65 cts.; steel plates, 1.55 to 1.65 cts. for tank, 1.75 to 1.85 cts. for shell, 1.95 to 2.05 cts. for flange, 2.75 to 3 cts. for firebox.